UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

Date: January 22, 2010

Chemical: Aminocyclopyrachlor
PC Code: 288008, 288009, 288010
DP Barcode: DP 358167

MEMORANDUM

SUBJECT: Transmittal Memo regarding the "Ecological Risk Assessment for the Section 3 New Chemical Registration of Aminocyclopyrachlor on Non-crop Areas and Turf"

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E.I. du Pont de Nemours and Company (DuPont) submitted a petition to the Environmental Protection Agency (EPA) to register the new chemical aminocyclopyrachlor. DuPont proposed two technical active ingredients (aminocyclopyrachlor acid and aminocyclopyrachlor methyl ester). The acid can also be formulated into aminocyclopyrachlor potassium salt. The proposed uses are on non-crop areas and turf for pre- and post-emergent control of broadleaf weeds and grasses. This memorandum summarizes the attached Environmental Fate and Effects Division (EFED)'s ecological risk assessment for aminocyclopyrachlor for the proposed uses.

Five technical and manufacturing concentrate labels and 29 labels for formulations were submitted under DP 368239 and 358167. EFED's assessment is based on all 29 end-use product labels. However, it was brought to EFED's attention on January 21, 2010 that some labels may be withdrawn. The exact number of labels and their identity that may be withdrawn were unknown at the time this assessment was completed. Because the proposed action to withdraw labels for consideration for registration has not been received by EFED, this assessment includes all 29 labels submitted under DP 368239 and 358167. If the registrant proposes to remove specified labels from consideration for registration, then EFED will submit an addendum to the attached ecological risk assessment if the remaining labels do not reflect the assessed uses.

Table A shows examples of the proposed application rates for the uses that have been modeled for this ecological risk assessment. See **Table 3.1** for a complete table containing all maximum proposed application rates for the 29 submitted product labels.

Table A. Maximum Application Rates from the Proposed Aminocyclopyrachlor Labels

Compound	Use	Application Method[1]	Single Application Rate (Interval between Applications)	Max. # of Applications[2]	Maximum Application Rate/ Year
Aminocyclopyrachlor Acid	Non-Crop	Aerial or Ground - WDG	0.284 lb a.e./A (NA)	1	0.284 lb a.e ./A
	Turf	Ground - G	0.108 lb a.e./A (30 days)	3	0.324 lb a.e ./A

NA = Not Applicable
[1]WDG = water dispersible granule; SC = soluble concentrate; G = granule.
[2]If not specified on label, number of applications may have been calculated based on maximum single application rate and maximum annual application rate.

Risks to Non-target Organisms

A screening-level risk assessment based on proposed uses suggests that aminocyclopyrachlor presents potential risks to both non-listed and listed terrestrial plants and to organisms that depend on terrestrial plants for habitat and forage. Due to lack of acceptable avian reproduction and freshwater invertebrate life cycle toxicity data, chronic risks to non-listed and listed birds and freshwater and estuarine/marine invertebrates are assumed.

Outstanding Data Requirements

No additional environmental fate data are recommended for request at this time.

Several additional environmental effects studies were identified as data gaps (see **Section 2.6.2**). The following two studies are high priority studies because they have the potential to add value to the assessment by characterizing potential risks by eliminating uncertainties for both non-listed and listed species that cannot be accounted for using alternate methods or weights or evidence.

Acid

- Avian Reproduction Toxicity Test (850.2300): Data are required for both an upland game and waterfowl species for the proposed use patterns. The submitted studies were classified as invalid due to improper husbandry practices (cage sizes that were much smaller than those recommended in the guideline) that may have caused incidental mortalities in quails and reduced egg production in mallards (see **Section 4.2.1**). Because of the lack of avian reproduction data, potential chronic risks to birds cannot be precluded for non-listed and listed species.

- Freshwater Invertebrate Life Cycle Toxicity Test (850.1300): Non dose-response mortalities were observed in the three lowest treatment levels (40%, 30%, and 40%, respectively) for the submitted freshwater daphnid study. Therefore, a NOAEC could not be established. Due to the high mortality observed in the first three treatment levels, the resulting toxicity values are not a reliable estimate of the chronic toxicity to water fleas (see **Section 4.1.2** for details).

Recommended Labeling Language

Following review of physicochemical properties and incident data of similar registered chemicals, EFED recommends that the following language be placed on all aminocyclopyrachlor labels:

Surface Water Advisory
This product may impact surface water quality due to spray drift and runoff of rain water. This is especially true for poorly draining soils and soils with shallow ground water. This product is classified as having high potential for reaching surface water via runoff for several months after application. A level, well-maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential loading of aminocyclopyrachlor from runoff water and sediment. Runoff of this product will be reduced by avoiding applications when rainfall is forecast to occur within 48 hours. See manual at the following Internet address:
http://www.wsi.nrcs.usda.gov/products/W2Q/pest/core4.html

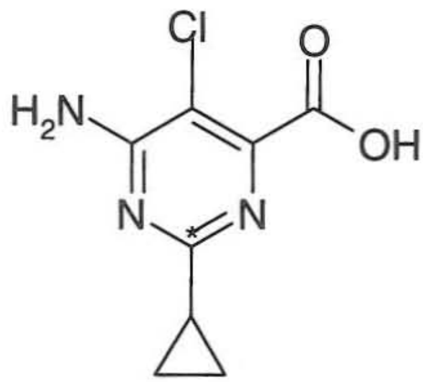
Ground Water Advisory
This chemical has properties and characteristics associated with chemicals detected in ground water. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow.

Residues in Plants or Manure
Do not use plant residues including grass or hay from treated areas or manure from animals being fed treated forage or hay for composting or mulching of desirable, susceptible broadleaf plants.

Do not use manure from animals grazing treated areas on land used for growing broadleaf crops, ornamentals, orchards or other susceptible, desirable plants. Manure may contain enough aminocyclopyrachlor to cause injury to susceptible plants.

In addition, EFED has concerns with spray drift management language on the proposed labels. The recommended droplet sizes (>150 to 200 microns) on the proposed labels are consistent with fine droplets according to the American Society of Agricultural and Biological Engineers (ASABE). The label characterizes these droplets as "large". Assuming large droplets are similar to course droplets as defined by ASABE, the volume median diameter (VMD) should be >326 microns. Recommended droplet sizes on the proposed labels need to be consistent with ASABE classifications of droplet size.

Ecological Risk Assessment for the Section 3 New Chemical Registration of Aminocyclopyrachlor on Non-crop Areas and Turf



CAS: 858956-08-8 (acid), 858954-83-3 (ester), 858956-35-1 (salt)
U.S. EPA PC Code: 288008 (acid), 288009 (ester), 288010 (salt)

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Date of Approval
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1 Executive Summary

1.1 Nature of Chemical Stressor

E.I. du Pont de Nemours and Company (DuPont) is seeking registration for aminocyclopyrachlor, an herbicide in the pyrimidine carboxylic acids class within the family of synthetic auxins. Aminocyclopyrachlor is proposed for registration in three different forms. Aminocyclopyrachlor acid (DPX-MAT28, referred to as the acid) and aminocyclopyrachlor methyl ester (DPX-KJM44, referred to as the ester) are technical active ingredients, and these, along with aminocyclopyrachlor potassium salt (referred to as the salt), are formulated into 29 different end-use products. These 29 product labels, which were submitted under DP368239 and DP358167, are included in this ecological risk assessment.

Aminocyclopyrachlor is a systemic herbicide; it is biologically active in soil and rapidly absorbed by roots and leaves. It is then translocated through xylem and phloem until it reaches the meristematic plant regions where it mimics the plant hormone auxin. Upregulation of a set of proteins responsible for gene repression and the loss of tight control of the expression of a set of genes that maintain hormonal balance result in undifferentiated cell division and elongation; however, the changes in regulation of gene expression have not been thoroughly described. Effects to target weeds include epinasty (downward bending of leaves), severe necrosis, stem thickening, growth stunting, leaf crinkling, calloused stems and leaf veins, leaf-cupping, and enlarged roots. These symptoms may begin a few hours to a few days after application, and plant death may take weeks to several months.

Aminocyclopyrachlor has been proposed for pre-emergent and post-emergent control of broadleaf weeds, woody species, vines, and grasses in uncultivated non-agricultural areas (airports, highway, railroad and utility rights-of-way, sewage disposal areas), uncultivated agricultural areas – non-crop producing (farmyards, fuel storage areas, fence rows, non-irrigation ditchbanks, barrier strips), industrial sites – outdoor (lumberyards, pipeline and tank farms), natural areas (wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails), and native grasses and turf grasses. **Table 1.1** contains maximum proposed application rates, which were assessed in this document; see **Table 3.1** for a complete rate table for all 29 proposed products.

Table 1.1. Maximum Application Rates from the Proposed Aminocyclopyrachlor Labels

Compound	Use	Application Method[1]	Single Application Rate (Interval between Applications)	Max. # of Applications[2]	Maximum Application Rate/ Year
Aminocyclopyrachlor Acid	Non-Crop	Aerial or Ground - WDG	0.284 lb a.e./A (NA)	1	0.284 lb a.e ./A
	Turf	Ground - G	0.108 lb a.e./A (30 days)	3	0.324 lb a.e ./A

NA = Not Applicable
[1]WDG = water dispersible granule; SC = soluble concentrate; G = granule.
[2]If not specified on label, number of applications may have been calculated based on maximum single application rate and maximum annual application rate.

DuPont proposed a bridging strategy to relate the environmental fate and toxicity data from one form to the other two forms of the chemical due to the ester hydrolyzing rapidly to the acid and the salt dissociating rapidly to the acid. Therefore, most studies were submitted for the acid only. In a few cases, studies were conducted with the ester to confirm equivalent toxicity or because it was a more appropriate product. No studies were submitted that evaluated the toxicity of the potassium salt. After review of the submitted data, EFED has determined that Dupont's proposed bridging strategy is not sufficient for evaluating toxicity to non-target organisms and has effected a different strategy considering the nature of the chemical (see **Sections 1.4 and 2.2.3**).

1.2 Potential Risks to Non-target Organisms

A screening-level risk assessment based on proposed uses suggests that aminocyclopyrachlor presents potential risks to both non-listed and listed terrestrial plants and to organisms that depend on terrestrial plants for habitat and forage. Due to lack of acceptable avian reproduction and freshwater invertebrate life cycle toxicity data, chronic risks to non-listed and listed birds and freshwater and estuarine/marine invertebrates are assumed.

Several major degradates were identified to be of possible concern. Due to the lack of submitted toxicity data for the degradates, potential risks were described (see **Section 5.2.3**) using methods such as structure activity relationships (SARs), total toxic residue (TTR) approach, and comparisons of environmentally relevant concentrations to effects thresholds. From this analysis, EFED was able to reduce uncertainties regarding potential risks due to exposures to the degradates in the absence of toxicity data.

Listed Species

Based on available screening level information, for the proposed uses of aminocyclopyrachlor, there is a potential for direct effects to listed terrestrial plants. Due to lack of acceptable data for the acid, direct effects are assumed for birds (chronic) and freshwater invertebrates (chronic). Consequently, direct effects must be assumed for estuarine/marine invertebrates (chronic). Submittal of a chronic avian reproduction study and chronic freshwater invertebrate study would reduce the uncertainties associated with the presumed risk to these taxa. Based on risks to terrestrial plants and presumed chronic risk to freshwater invertebrates and birds, there is a potential concern for indirect effects to listed species via habitat perturbation and/or reduction in the availability of forage or prey. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-endangered organisms in these taxonomic groups as resources critical to their life cycle. A summary of the risk conclusions and direct and indirect effects determinations is presented in **Table 1.1**. Because the proposed uses of aminocyclopyrachlor cannot be geographically limited, all federally listed species may be either directly or indirectly affected.

Table 1.2. Potential Listed Species Risks Associated with Direct or Indirect Effects Due to the Proposed Applications of Aminocyclopyrachlor

Listed Taxonomy	Direct Effects	Indirect Effects[2]
Terrestrial and semi-aquatic plants – monocots	Yes	Yes

Table 1.2. Potential Listed Species Risks Associated with Direct or Indirect Effects Due to the Proposed Applications of Aminocyclopyrachlor		
Listed Taxonomy	**Direct Effects**	**Indirect Effects[2]**
Terrestrial and semi-aquatic plants – dicots	Yes	Yes
Terrestrial invertebrates	No	Yes
Birds (surrogate for terrestrial-phase amphibians and reptiles)	No – acute Assumed[1] – chronic	Yes
Mammals	No – acute No – chronic	Yes
Aquatic vascular plants	No	Yes
Aquatic non-vascular plants	No	Yes
Freshwater fish (surrogate for aquatic-phase amphibians)	No – acute No – chronic	Yes
Freshwater Invertebrates	No – acute Assumed[1] – chronic	Yes
Freshwater Benthic Invertebrates	No – acute Assumed[1] - chronic	Yes
Estuarine/Marine Fish	No – acute No – chronic	Yes
Estuarine/Marine Crustaceans	No – acute Assumed[1] – chronic	Yes
Estuarine/Marine Mollusks	No	Yes
[1]Direct effects assumed in the absence of acceptable data for the acid. [2]Indirect effects are possible for all taxa due to the direct effects to terrestrial and semi-aquatic plants.		

Incidents

Although no incidents have been reported for aminocyclopyrachlor because it is a new chemical, several incidents have been reported for a similar class of chemicals, the pyridine carboxylic acids. Incidents involving herbicides such as aminopyralid, picloram, and clopyralid were reported when treated plant residues or manure from animals fed treated residues were used in compost. The compost was then spread on areas where desirable crops or lawns were grown, and crop damage, which may have been caused by a pyridine carboxylic acid herbicide, was observed (see **Section 4.4** for more details). Some states as well as the United Kingdom were prompted to take regulatory action because of these incidents. Because aminocyclopyrachlor also shares the persistent and systemic nature in soil and the high seedling emergence toxicity with these similar chemicals, similar incidents could occur following the application of aminocyclopyrachlor.

1.3 Conclusions: Exposure Characterization

Based on the registrant-submitted studies, the following conclusions were drawn regarding the environmental fate of aminocyclopyrachlor:

- Aminocyclopyrachlor is non-volatile (3.7×10^{-8} mm Hg and $K_H = 3.47 \times 10^{-12}$ atm-m^3/mol) and highly soluble (2810 mg/L at 20°C) in water. Based on the batch equilibrium data, aminocyclopyrachlor displays an affinity to organic carbon. Adsorption (K_{oc} = 2 to 26 mL/g_{oc}) is characterized as being highly mobile to mobile in the test soils.

Therefore, dissipation of aminocyclopyrachlor in the environment is expected to occur predominantly from runoff and leaching.

- The octanol/water partition coefficient (log K_{ow} of -2.48 at 20° at pH 7) for aminocyclopyrachlor suggests that it has a low tendency for bioaccumulation.

- Considering biodegradation, aminocyclopyrachlor is persistent in aerobic aquatic and aerobic terrestrial environments. In addition, it is relatively stable in anaerobic aquatic and anaerobic terrestrial environments.

- Considering abiotic degradation, aqueous photolysis is the major route of degradation and aminocyclopyrachlor is expected to degrade with a half-life of 1.2 days in shallow, clear, and well-lit natural (pH 6.2) water bodies and 7.8 days in pH 4 buffer solution. However, it is slowly photolyzed on soil ($t_{1/2}$ = 129 days). Aminocyclopyrachlor is stable to hydrolysis at pH 4, 7, and 9.

- Dissipation occurred with half-lives ranging from 22 to 126 days in terrestrial field dissipation studies conducted in the continental United States and Canada.

- The major transformation products of aminocyclopyrachlor of concern at this time are IN-LXT69, IN-V0977 and IN-YY905.However, these degradates are not expected to occur at environmentally relevant concentrations relative to effects thresholds.

Conclusions regarding the environmental exposure concentrations for aminocyclopyrachlor are presented below:

- Aquatic EECs produced by GENEEC ranged from 16.64 ppb (60-day) to 16.86 ppb (peak) for aerial spray applications to non-crop areas for one application at a rate of 0.284 lb a.e./acre. EECs ranged from 16.26 ppb (60-day) to 16.47 ppb (peak) for ground spray applications to non-crop areas for one application at a rate of 0.284 lb a.e./acre. For ground granular applications at a rate of three applications at 0.108 lb a.e./acre (30-day interval), EECs ranged from 16.60 ppb (60-day) to 16.82 ppb (peak).

- Considering the highest proposed application rate (one application at 0.284 lb a.e./acre), dietary-based exposure concentrations for terrestrial wildlife ranged from 4.26 to 68.16 ppm. Avian and mammalian oral dose concentrations ranged from 0.28 to 77.63 mg/kg-bw and 0.14 to 64.99 mg/kg-bw, respectively. Terrestrial and semi-aquatic plant EECs ranged from 0 to 0.1562 ppm.

1.4 Conclusions: Effects Characterization

Based on the registrant-submitted studies, the following conclusions were drawn regarding the environmental effects of aminocyclopyrachlor:

- Studies that evaluated the effects of the acid (DPX-MAT28) and the ester (DPX-KJM44) were submitted for aquatic flora and fauna. Toxicity classifications for acute studies ranged from practically non-toxic to slightly toxic. The acute freshwater fish and daphnid studies showed that the ester may be more toxic than the acid. No effects were observed in the chronic freshwater fish study, and a toxicity value could not be obtained from the chronic freshwater invertebrate study (see **Section 4.1.2**).

- For the most part, aminocyclopyrachlor was practically non-toxic to birds, mammals, and honey bees. As expected since aminocyclopyrachlor is an herbicide, toxicity based on seedling emergence and vegetative vigor endpoints were observed in the plant studies.

1.5 Data Gaps

No environmental fate data gaps were identified.

Several environmental effects data gaps were identified (see **Section 2.6.2**). The following two studies are high priority studies because they have the potential to add value to the assessment by characterizing potential risks by eliminating uncertainties for both non-listed and listed species that cannot be accounted for using alternate methods or weights or evidence.

Acid

- Avian Reproduction Toxicity Test (850.2300): Data are required for both an upland game and waterfowl species for the proposed use patterns. The submitted studies were classified as invalid due to improper husbandry practices (cage sizes that were much smaller than those recommended in the guideline) that may have caused incidental mortalities in quails and reduced egg production in mallards (see **Section 4.2.1**). Because of the lack of avian reproduction data, potential chronic risks to birds cannot be precluded for non-listed and listed species.

- Freshwater Invertebrate Life Cycle Toxicity Test (850.1300): Non dose-response mortalities were observed in the three lowest treatment levels (40%, 30%, and 40%, respectively) for the submitted freshwater daphnid study. Therefore, a NOAEC could not be established. Due to the high mortality observed in the first three treatment levels, the resulting toxicity values are not a reliable estimate of the chronic toxicity to water fleas (see **Section 4.1.2** for details).

2 Problem Formulation

2.1 Nature of Regulatory Action

The purpose of this assessment is to evaluate the environmental fate and ecological risks for the registration of the new chemical aminocyclopyrachlor. Aminocyclopyrachlor can be used pre- or post-emergently to control broadleaf weeds, woody species, vines, and certain grasses in non-agricultural areas, agricultural non-crop areas, industrial sites, natural areas, and in a residential and commercial setting for the protection of turf. As a new chemical, U.S. EPA is required under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) to ensure that aminocyclopyrachlor does not have the potential to cause unreasonable adverse effects to the environment. Potential effects to listed species (*i.e.*, species on the Federal list of endangered and threatened wildlife and plants) are also considered under the Endangered Species Act in order to ensure that the registration of aminocyclopyrachlor is not likely to jeopardize the continued existence of such listed species or adversely modify their habitat. To these ends, this assessment follows U.S. EPA guidance on conducting ecological risk assessments (U.S. EPA, 1998) and the Office of Pesticide Program's policies for assessing risk to non-target and listed organisms (U.S. EPA, 2004).

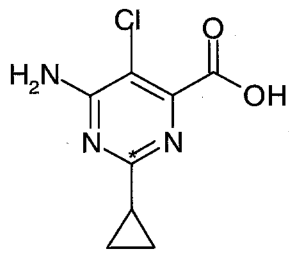
Among the end products of the U.S. EPA pesticide registration process is a determination of whether a product is eligible for registration and, if so, an enforceable description of how the product may be used. A label represents the legal document which stipulates how and where a given pesticide may be used. End-use labels describe the formulation type, acceptable methods of application, where the product may be applied, and any restrictions on how applications may be conducted. Thus, the use, or potential use, described by the pesticide's labels is considered "the action" being assessed.

2.2 Stressor Source and Distribution

2.2.1 Nature of the Chemical Stressor

Aminocyclopyrachlor is a synthetic auxin and is the first member of a new class of chemistry called the pyrimidine carboxylic acids. This new class is similar to the pyridine carboxylic acid class, which includes herbicides such as aminopyralid, clopyralid, and picloram. The chemical's major route of degradation is aqueous photolysis. Aminocyclopyrachlor is stable to hydrolysis at pH 4 and 7. Aminocyclopyrachlor is expected to be highly mobile to mobile. It has low volatility and is highly soluble in water. Therefore, dissipation of aminocyclopyrachlor from the application site is expected to occur predominantly via aqueous photolysis, runoff, and leaching. Chemical characteristics of aminocyclopyrachlor and field dissipation studies suggest that residues may leach into ground water. Additionally, off-site movement of aminocyclopyrachlor is expected through spray drift from aerial and ground spray. A summary of the chemistry and environmental fate data on aminocyclopyrachlor is provided in **Table 2.1;** more detailed descriptions of the submitted environmental fate data can be found in **Section 3.2.1**.

Table 2.1. Nature of the Chemical Stressor – Aminocyclopyrachlor Acid		
		Source / MRID(s)
Common Name:	Aminocyclopyrachlor	--
Pesticide Class:	synthetic auxin herbicide (pyrimidine carboxylic acid)	--
EPA PC Code:	288008 (acid), 288009 (ester), 288010 (salt)	--
IUPAC Name:	6-Amino-5-chloro-2-cyclopropylpyrimidine-4-carboxylic acid	--

Table 2.1. Nature of the Chemical Stressor – Aminocyclopyrachlor Acid		
		Source / MRID(s)
CAS Name(s):	6-Amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid 6-Amino-5-chloro-2-cyclopropyl-pyrimidine-4-carboxylic acid	--
CAS No:	858956-08-8	--
Formula:	$C_8H_8ClN_3O_2$	--
Structure:		--
Molecular Mass (g/mol)	213.62	--
Vapor pressure (torr) at 25° C	3.7 x 10^{-8}	475598-18
Henry's Law Constant at 20° C (atm m^3/mol)	3.47 x 10^{-12} at pH 7	475598-20
Solubility in Water (mg/L) at 20 °C	2810 in Milli-Q water 3130 at pH 4 4200 at pH 7 3870 at pH 9	475598-16
Octanol- Water Partition Coefficient (Log K_{ow}) at 20 °C	-1.12 at pH 4 - 2.48 at pH 7	475598-15
Dissociation Constant pKa at 20°C	4.65	475598-14

2.2.2 Mode of Action

According to the registrant, aminocyclopyrachlor is a systemic herbicide; it is biologically active in soil and rapidly absorbed by roots and leaves. It is then translocated through xylem and phloem until it reaches the meristematic plant regions where it mimics the plant hormone auxin. Upregulation of a set of proteins responsible for gene repression and the loss of tight control of the expression of a set of genes that maintain hormonal balance result in undifferentiated cell division and elongation; however, the changes in regulation of gene expression have not been thoroughly described. Effects to target weeds include epinasty, severe necrosis, stem thickening, growth stunting, leaf crinkling, calloused stems and leaf veins, leaf-cupping, and enlarged roots. These symptoms may begin a few hours to a few days after application and death may take weeks to several months.

2.2.3 Environmental Fate and Effects Bridging Strategy

There are three proposed forms of aminocyclopyrachlor: (1) an acid, (2) a methyl ester, and (3) a potassium salt. The registrant did not submit a full suite of required studies for each form of the chemical. Instead, the registrant submitted mostly full suites of environmental fate and effects studies for the acid form of aminocyclopyrachlor, limited data were submitted for the methyl ester, and only a dissociation study was submitted for the potassium salt. All fate and toxicological values were converted to the acid equivalent (a.e.) based on the ratio of molecular weights. This was done for ease of comparing fate parameters and toxicity values across the various forms of aminocyclopyrachlor. It was determined, based on the submitted study, that the potassium salt dissociates to the acid rapidly prior to application (when mixed with water as the two salt formulation labels state) and that the methyl ester hydrolyzes to the acid in the environment (**Figure 1**). Available environmental fate data submitted by the registrant are summarized in **Tables 3.2**, **3.3**, and **3.4**.

Figure 1. Schematic of Bridging Strategy of Aminocyclopyrachlor Methyl Ester and Aminocyclopyrachlor Potassium Salt to Aminocyclopyrachlor Acid

ACP Potassium Salt → dissociation in water → ACP Acid + Potassium Cation (K^+)

ACP Methyl Ester → microbial-mediated hydrolysis → ACP Acid + Alcohol (methanol)
alkaline-catalyzed hydrolysis

To assess the dissociation of the potassium salt, the registrant submitted a laboratory study of the dissociation constant (MRID 478909-01). The dissociation constant of aminocyclopyrachlor acid was previously determined to be 4.65. The dissociation constant of the salt was determined to be 4.63 when conducting measurements within 2 to 7 minutes after the addition of the test substance to the test system. This study supports the rapid conversion of the salt to the anionic conjugate base of the acid and the potassium cation. This similarity in dissociation constants supports like behavior of aminocyclopyrachlor acid and aminocyclopyrachlor potassium salt once dissociated.

Therefore, environmental fate and toxicity data submitted on the acid is also relevant for the potassium salt for the currently proposed uses; if different formulations of the salt are proposed in the future where the salt would be released to the environment rather than dissociating to the acid prior to application (for instance, a granular salt formulation), a full suite of salt toxicity data may be necessary.

The submitted laboratory and terrestrial field dissipation data indicate the aminocyclopyrachlor methyl ester is hydrolyzed in alkaline aquatic environments, moist soils, and soil/water slurries. Degradation under environmentally relevant pH conditions is primarily microbe-mediated. Therefore, use of the methyl ester end-use products of aminocyclopyrachlor may result in short-term exposures to the methyl ester form of aminocyclopyrachlor. However, the methyl ester is expected to degrade to the acid form of aminocyclopyrachlor rapidly under most environmental conditions.

The de-esterification of aminocyclopyrachlor methyl ester is more difficult to generalize because it is dependent on heterogeneous hydrolysis (microbe-mediated) and homogeneous hydrolysis (abiotic alkaline catalyzed (Schwarzenbach *et al.*, 1993). The de-esterification of aminocyclopyrachlor methyl ester leads to the formation of the aminocyclopyrachlor acid and the associated alcohol, methanol. Unlike the physical dissociation mechanism of the aminocyclopyrachlor potassium salt, the de-esterification of aminocyclopyrachlor methyl ester is dependent on abiotic and microbe-mediated processes. Any environmental variable influencing microbe populations or activity could theoretically influence the persistence of aminocyclopyrachlor methyl ester. Soil properties including clay mineralogy, organic carbon content, temperature, and moisture content are known to influence hydrolysis rates (Wolfe *et al.*, 1989 and Wolfe, 1990).

Registrant-sponsored research indicates that aminocyclopyrachlor methyl ester degrades to form the acid. In the hydrolysis study (MRID 478357-01), the calculated half-lives at 20°C for pH 4, 7 and 9 were 27, 52 and 0.3 days, respectively. This data suggests alkaline-catalyzed abiotic hydrolysis. Since the hydrolysis study is conducted in a sterile (abiotic) environment, an aerobic soil metabolism (MRID 475602-14) and a batch equilibrium (MRID 475602-18) study were investigated. In the aerobic soil metabolism study, the half-life could not be accurately calculated because of the rapid transformation to the aminocyclopyrachlor acid in acidic soil (pH = 5.4). In the batch equilibrium studies, rapid degradation of the test substance was also observed in acidic and alkaline soils. The weight of evidence from the aerobic soil metabolism and batch equilibrium (biotic) studies suggest a microbe-mediated hydrolytic process at lower pHs.

Only two aquatic studies were submitted for the ester (see **Section 4**). The submitted data did not confirm equivalent toxicity; the freshwater fish toxicity value was about an order of magnitude more toxic for the ester than the acid and the freshwater invertebrate toxicity value was about twice as toxic for the ester than the acid. Although acute terrestrial toxicity (based on submitted toxicity data) and chronic terrestrial and chronic aquatic toxicity (based on submitted fate data) for the ester is suspected to be equivalent to the acid, other aquatic taxa may be exposed to the ester on an acute basis.

2.3 Overview of Pesticide Usage

Aminocyclopyrachlor has been proposed for pre-emergent and post-emergent control of broadleaf weeds, woody species, vines, and grasses in uncultivated non-agricultural areas (airports, highway, railroad and utility rights-of-way, sewage disposal areas), uncultivated agricultural areas – non-crop producing (farmyards, fuel storage areas, fence rows, non-irrigation ditchbanks, barrier strips), industrial sites – outdoor (lumberyards, pipeline and tank farms), natural areas (wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails), and native grasses and turf grasses. The proposed use areas are found throughout the United States and cannot be limited to a geographic region. Because aminocyclopyrachlor is a new chemical, use data does not yet exist.

2.4 Receptors

2.4.1 Aquatic and Terrestrial Effects

The receptor is the biological entity that is exposed to the stressor (U.S. EPA, 1998). Consistent with the process described in the Overview Document (U.S. EPA, 2004), this risk assessment uses a surrogate species approach in its evaluation of aminocyclopyrachlor. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

Acute and chronic toxicity data from studies submitted by pesticide registrants along with any available open literature are used to evaluate the potential direct effects of aminocyclopyrachlor to the aquatic and terrestrial receptors identified in this section. This includes toxicity data on the technical grade active ingredient, degradates, and when available, formulated products (*e.g.*, "Six-Pack" studies). The open literature studies are identified through U.S. EPA's publicly available ECOTOX database (http://cfpub.epa.gov/ecotox/), which employs a literature search engine for locating chemical toxicity data for aquatic life, terrestrial plants, and wildlife. The evaluation of both sources of data can also provide insight into the direct and indirect effects of aminocyclopyrachlor on biotic communities from loss of species that are sensitive to the chemical and from changes in structure and functional characteristics of the affected communities.

2.4.2 Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope; as a result, it may not be possible to identify specific ecosystems during the development of a baseline risk assessment. However, in general terms, terrestrial ecosystems potentially at risk could include the treated field and areas immediately adjacent to the treated field that may receive drift or runoff. Areas adjacent to the treated field could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats and other uncultivated areas.

Aquatic ecosystems potentially at risk include water bodies adjacent to, or down stream from, the treated field and might include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

2.4.3 Ecological Effects

Each assessment endpoint requires one or more "measures of ecological effect," which are defined as changes in the attributes of an assessment endpoint itself or changes in a surrogate entity or attribute in response to exposure to a pesticide. Ecological measurement endpoints for this risk assessment would be based on toxicity information for aminocyclopyrachlor in the publicly available ECOTOX database (if available) and a suite of registrant-submitted toxicity studies performed on a limited number of organisms in the following broad groupings:

1. Birds (mallard duck or bobwhite quail and a passerine species), also used as a surrogate for terrestrial-phase amphibians and reptiles
2. Mammals (laboratory rat)
3. Freshwater fish (rainbow trout and bluegill sunfish), also used as a surrogate for aquatic-phase amphibians
4. Freshwater invertebrates (daphnid)
5. Estuarine/marine fish (sheepshead minnow)
6. Estuarine/marine invertebrates (Eastern oyster, mysid shrimp)
7. Terrestrial plants (monocots and dicots)
8. Aquatic plants (vascular and non-vascular plants)
9. Terrestrial invertebrates (honeybee)

Within each of these very broad taxonomic groups, an acute and chronic endpoint is selected from the available test data, as the data allow.

2.5 Conceptual Model

A conceptual model provides a written description and visual representation of the predicted relationships between aminocyclopyrachlor, potential routes of exposure, and the predicted effects for the assessment endpoint. A conceptual model consists of two major components: risk hypotheses and a conceptual diagram (U.S. EPA, 1998).

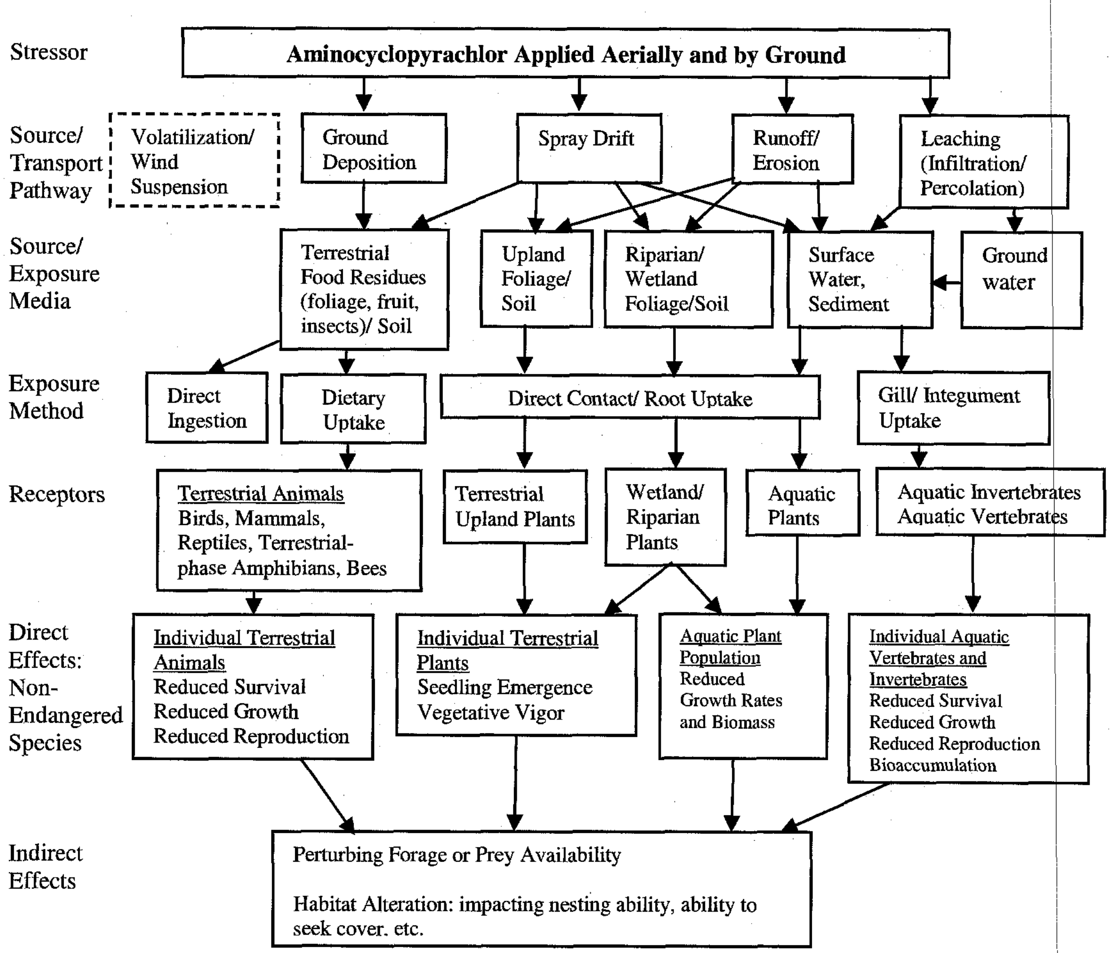
2.5.1 Risk Hypotheses

- Terrestrial and aquatic organisms are subject to adverse direct effects such as reduced survival, growth, and fecundity or indirect effects such as habitat, food web dynamics, perturbing forage or prey availability, and altering the extent and nature of nesting when exposed to aminocyclopyrachlor/degradate residues as a result of labeled use of the pesticide.
- Non-target terrestrial, semi-aquatic, and aquatic plants are subject to adverse effects such as reductions in vegetative vigor and seedling emergence (terrestrial) or biomass and growth rate (aquatic) when exposed to aminocyclopyrachlor/degradate residues as a result of labeled use of the pesticide

2.5.2 Conceptual Diagram

In order for a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a contaminant moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure. In addition, the potential mechanisms of transformation (*i.e.*, which degradates may form in the environment, in which media, and how much) must be known, especially for a chemical whose metabolites/degradates are of greater toxicological concern. The assessment of ecological exposure pathways, therefore, includes an examination of the source and potential migration pathways for constituents, and the determination of potential exposure routes (*e.g.*, ingestion, inhalation, and dermal absorption).

Figure 2. Conceptual model depicting ecological risk based on proposed aminocyclopyrachlor applications. Dotted boxes indicated pathways not considered in the risk assessment.



Based on the labels submitted by the registrant, the source and mechanisms of release for aminocyclopyrachlor are aerial and/or ground application in the form of soluble concentrates and water dispersible granules (for non-crop uses and some professional turf uses) or ground application as a granule (with a fertilizer for all residential and most professional turf uses). The conceptual model and subsequent analysis of exposure and effects are all based both on the parent and degradates (where data are available) of aminocyclopyrachlor. Potential emission of volatile compounds is not considered as a viable release mechanism for aminocyclopyrachlor, because Henry's Law constant (3.47×10^{-12} atm-m^3/mol) suggests that volatilization is not expected to be a significant route of dissipation for this chemical (indicated by dashed lines in the diagram). Aminocyclopyrachlor concentrations in surface waters may be relatively high when significant runoff events occur after application and/or spray drift to water bodies in close proximity to the treatment area occurs. Aminocyclopyrachlor has the potential to leach to ground water, which can serve as inputs to surface water. The conceptual model shown in **Figure 2** generically depicts the potential source of aminocyclopyrachlor, release mechanisms, abiotic receiving media, and biological receptor types.

2.6 Analysis Plan

This assessment characterizes the environmental fate and effects of aminocyclopyrachlor and determines whether there is potential for risks to non-target organisms based on the proposed use patterns. Available environmental fate, ecotoxicity, and physicochemical property data were taken from submitted studies to the Agency. The environmental fate and effects studies underwent reviews to determine their acceptability relative to published U.S. EPA guidelines.

The maximum proposed label application rates for the use of aminocyclopyrachlor on non-crop areas and turf were selected for modeling environmental concentrations for this base-level deterministic (risk-quotient based) assessment. The most sensitive toxicity endpoints from surrogate test species are used to estimate treatment-related effects on survival, growth, and reproduction. Estimated environmental concentrations (EECs) used in terrestrial and aquatic ecological risk assessments are based on the parent aminocyclopyrachlor compound. Because toxicity data has not been submitted for any of the degradates, EECs were not calculated for any degradates; however the total toxic residue approach was used to describe potential risks. For the aquatic assessment, EECs are initially produced by GENEEC. If LOC exceedances were to occur when comparing EECs to the toxicity values, PRZM/EXAMS would then be used to refine exposure estimates. For the terrestrial assessment, EECs are produced by T-REX and TerrPlant. To evaluate the spatial extent of risk to non-target terrestrial plants, AgDRIFT is used to determine at what distance from the application area LOCs are no longer exceeded.

The following sections characterize the use, environmental fate, and ecological effects of aminocyclopyrachlor and use the risk quotient (ratio of EEC to toxicity value) approach to estimate the potential for adverse effects on non-target terrestrial and aquatic organisms. This risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. Such estimates may be possible through a more refined, probabilistic assessment; however, they are beyond the scope of this base-level assessment.

2.6.1 Measures of Effect and Exposure

Table 2.2 lists the measures of environmental exposure and ecological effects used to assess the potential risks of aminocyclopyrachlor to non-target organisms (U.S. EPA, 2004).

Table 2.2. Measures of Environmental Exposure and Ecological Effects Used to Assess the Potential Risks of Aminocyclopyrachlor to Non-target Organisms		
Assessment Endpoint	**Measures of Effect**	**Measures of Exposure**
Abundance (*i.e.*, survival, reproduction, and growth) of individuals and populations of birds	Bobwhite quail/ mallard duck acute oral LD_{50} Bobwhite quail/ mallard duck sub-acute dietary LC_{50} Bobwhite quail/ mallard duck chronic reproduction NOAEC and LOAEC	Maximum residues on food items (foliar)
Abundance (*i.e.*, survival, reproduction, and growth) of individuals and populations of mammals	Laboratory rat acute oral LD_{50} Laboratory rat 2-generation NOAEC and LOAEC	
Abundance (*i.e.*, survival, reproduction, and growth) of individuals and communities of freshwater fish	Rainbow trout and bluegill sunfish LC_{50}	Peak EEC
	Rainbow trout and/or bluegill sunfish NOAEC and LOAEC	60-day average EEC
Abundance (*i.e.*, survival, reproduction, and growth) of individuals and communities of freshwater invertebrates	Daphnid EC_{50}	Peak EEC
	Daphnid life cycle NOAEC and LOAEC	21-day average EEC
Abundance (*i.e.*, survival, reproduction, and growth) of individuals and communities of estuarine/marine fish and invertebrates	Sheepshead minnow acute LC_{50} Eastern oyster EC_{50} Mysid shrimp LC_{50}	Peak EEC
	Sheepshead minnow NOAEC and LOAEC Mysid shrimp NOAEC and LOAEC	60-day average EEC 21-day average EEC
Survival of beneficial insect populations and natural Lepidoptera predators	Honeybee acute contact LD_{50}	Single Maximum application rate
Maintenance and growth of individuals and populations of terrestrial plants from standing crop or biomass	Monocot EC_{25} and NOAEC values for seedling emergence and vegetative vigor (survival and growth rate) Dicot EC_{25} and NOAEC values for seedling emergence and vegetative vigor (survival and growth rate)	Estimates of runoff and spray drift to non-target areas
Maintenance and growth of individuals and populations of aquatic plants from standing crop or biomass	Vascular plant (*i.e.*, Lemna) EC_{50} and NOAEC values for growth rate and biomass measurements Non-vascular plant (*i.e.*, green algae) EC_{50} and NOAEC values for growth rate and biomass measurements	Peak EEC

2.6.2 Data Gaps

No environmental fate data gaps were identified.

Data gaps for environmental effects were assigned a low or high priority based on their potential to add value to the ecological risk assessment. While still considered data gaps according to 40 CFR Part 158, low priority studies are unlikely to change risk determinations because alternate methods and weights of evidence (*i.e.,* acute-to-chronic ratio, scaling factors, or consideration of environmentally relevant concentrations relative to effects thresholds) can be used in the absence of data. High priority studies are needed to characterize potential risks by eliminating uncertainties for both non-listed and listed species that cannot be accounted for using alternate methods or weights of evidence. It is important to note that a study that is currently assigned a low priority based on its potential to add value could be changed to high priority based on future proposed uses, submitted data, and/or incidents.

The following environmental effects data gaps were identified:

Acid

- Avian Acute Oral Toxicity Test (850.2100): Data are required for one passerine species and either one waterfowl species or one upland game bird species for terrestrial, aquatic, forestry, and residential outdoor uses. The current method of calculating a weight-adjusted LD_{50} using bobwhite quail or mallard duck data may over- or under-estimate risks to passerines because these birds may metabolize the chemical differently. Because the 850.2100 guideline has not yet been finalized, protocols for the study of passerine species should be submitted to EPA for approval prior to study initiation. This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Avian Reproduction Toxicity Test (850.2300): Data are required for both an upland game and waterfowl species for the proposed use patterns. The submitted studies were classified as invalid due to improper husbandry practices (cage sizes that were much smaller than those recommended in the guideline) that may have caused incidental mortalities in quails and reduced egg production in mallards (see **Section 4.2.1**). Because of the lack of avian reproduction data, potential chronic risks to birds cannot be precluded for non-listed and listed species. This study has a **high** priority based on its potential to add value to the ecological risk assessment.

- Estuarine/Marine Fish Early-life Stage Toxicity Test (850.1400): The proposed use patterns indicate that aminocyclopyrachlor may enter estuarine/marine environments. The acute-to-chronic ratio cannot be used to predict potential chronic risks to estuarine/marine fish because there were no definitive acute or chronic values for the acid. In addition, the acute estuarine/marine fish study produced a non-definitive LC_{50}. This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Freshwater Invertebrate Life Cycle Toxicity Test (850.1300): Non dose-response mortalities were observed in the three lowest treatment levels (40%, 30%, and 40%, respectively) for the submitted freshwater daphnid study. Therefore, a NOAEC could not be established. Due to the high mortality observed in the first three treatment levels, the resulting toxicity values are not a reliable estimate of the chronic toxicity to water fleas (see **Section 4.1.2** for details). This study has a **high** priority based on its potential to add value to the ecological risk assessment.

- Estuarine/Marine Invertebrate Life Cycle Toxicity Test (850.1350): The proposed use patterns indicate that aminocyclopyrachlor may enter estuarine/marine environments. Due to the lack of a definitive chronic NOAEC in freshwater invertebrates, the acute-to-chronic ratio cannot be used to predict potential chronic risks to estuarine/marine invertebrates. This study has a **low** priority based on its potential to add value to the ecological risk assessment.

Ester

- Estuarine/Marine Fish Acute Toxicity Test (850.1075). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Estuarine/Marine Mollusk Acute Toxicity Test (850.1025). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Estuarine/Marine Invertebrate Acute Toxicity Test (850.1035). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Aquatic Plant Toxicity Test (850.4400). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

- Algal Toxicity Test (850.5400). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

Salt

- The two proposed salt formulations specify mixing with water prior to application. This is expected to cause the salt to dissociate to the acid in which case the salt is not expected to be released into the environment. Therefore, salt studies are not requested at this time. However, if future uses enable the salt to be applied to the environment (such as with a granular salt formulation), a full suite of acute and chronic toxicity data may be needed to adequately assess potential risks. These studies are currently in reserved status.

Degradates

- ECOSAR was used to predict aquatic toxicity of the degradates since no data were submitted. The results of this modeling indicated that there are two potential degradates of concern for aquatic organisms (see **Section 5.2.3**). Freshwater invertebrates may be chronically exposed to IN-LXT69 and IN-YY905. Because reliable SARs do not exist for terrestrial ecotoxicity estimation, EFED defers to HED's SAR evaluation in the absence of degradate toxicity data (D370368, October 15, 2009). HED determined that IN-V0977 (cyclopropanecarboxylic acid) may be more toxic than the parent to mammals. IN-V0977 has the potential to form in aquatic environments through aqueous photolysis and may be more mobile than the parent. Acute and chronic exposures to birds and mammals are possible. However, to determine the potential to add value to a risk assessment, the total toxic residue and comparisons of EECs to the effects thresholds approaches were used to assign a priority for the receipt of additional studies.

For IN-LXT69 and IN-YY905:

- Freshwater Invertebrate Life Cycle Toxicity Test (850.1300). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

For IN-V0977:

- Avian Acute Oral Toxicity Test (850.2100). This study has a **low** priority based on its potential to add value to the ecological risk assessment.
- Avian Acute Dietary Toxicity Test (850.2200). This study has a **low** priority based on its potential to add value to the ecological risk assessment.
- Avian Reproduction Toxicity Test (850.2300). This study has a **low** priority based on its potential to add value to the ecological risk assessment.
- Mammalian Acute Oral Toxicity Test (870.1100). This study has a **low** priority based on its potential to add value to the ecological risk assessment.
- Mammalian Oral Two Generation Reproduction Toxicity Test (870.3800). This study has a **low** priority based on its potential to add value to the ecological risk assessment.

3 Exposure Analysis

3.1 Use Characterization

Aminocyclopyrachlor, a systemic herbicide that is the first member within the new pyrimidine carboxylic acid class of chemistry, is proposed for registration under FIFRA. Aminocyclopyrachlor acid (DPX-MAT28) and aminocyclopyrachlor methyl ester (DPX-KJM44) are the two technical active ingredients; the acid is also formulated into aminocyclopyrachlor potassium salt. Due to the observed rapid hydrolysis of the methyl ester in environmental systems and dissociation of the potassium salt to the acid in tank mixtures, it is appropriate to bridge data for the salt to the acid and terrestrial and chronic aquatic data for the ester to the acid (see **Section 2.2.3**). However, it is possible, based on the submitted data, that aquatic organisms could be exposed to the ester on an acute basis. Because of the possibility of acute exposure combined with the submitted data showing that the ester is more acutely toxic to aquatic organisms than the acid, acute aquatic toxicity data for the ester is not bridged to the acid.

According to the proposed labels, aminocyclopyrachlor may be used against a variety of broadleaf weeds, woody species, vines, and tall grasses. The registrant is seeking initial registration for non-crop and turf uses.

For non-crop use, aminocyclopyrachlor is a dispersible granule that is mixed in water and may be applied by aerial or ground application methods for pre- or post-emergence for control of broadleaf weeds and grass species. A single application of 0.284 lb a.e./acre can be applied for a yearly maximum application rate of 0.284 lb a.e./acre.

For residential or commercial turf use, aminocyclopyrachlor is applied with a fertilizer as a granule that allows selective pre- or post-emergent broadleaf weed control in cool season and certain warm season turf grasses on lawns (residential, industrial, and institutional), golf courses, parks, cemeteries, athletic fields, and sod fields. Commercial turf uses can also be applied as a spray as soluble concentrate and water-dispersible granule formulations are proposed for registration. Aminocyclopyrachlor may control every major broadleaf weed, some of which include dandelion, clover, plantains, wild violet and ground ivy. Aminocyclopyrachlor can be applied only by ground application methods for turf uses. Three applications of 0.108 lb a.e./acre can be applied with a 30-day application interval for a yearly maximum application rate of 0.324 lb a.e./acre (commercial use rate).

Table 3.1 summarizes the proposed application rates and methods for 29 end-use products. Four products also contain other active ingredients (sulfometuron, chlorsulfuron, metsulfuron, and imazapyr); however, this assessment only addresses potential risks due to exposure to aminocyclopyrachlor. **Table 3.1** does not include the technical labels or the manufacturing concentrate labels (352-TIG, 352-TIE, 352-TOA, 352-TOL, 352-TIU).

Table 3.1. Proposed Application Rates for 29 Products Containing Aminocyclopyrachlor						
Product	**EPA File Symbol (a.i. form)**	**% a.e.**	**Application Method & Formulation Type[1]**	**Maximum Single Application Rate (lb a.e./acre)**	**Maximum Number of Applications/Year[2] (Application Interval)**	**Maximum Application Rate/Year (lb a.e./acre)**
Non-crop Uses						
DuPont™ DPX-MAT28 240SL Herbicide	352-TIA (salt)	*	Ground/Aerial – SC	0.281	1	0.281
DuPont™ DPX-KJM44 80XP Herbicide	352-TIL (ester)	75	Ground/Aerial – WDG	0.281	1	0.281
DuPont™ DPX-MAT28 50SG Herbicide	352-TIT (acid)	50	Ground/Aerial – WDG	0.281	1	0.281
DuPont™ DPX-Q2B37 Herbicide (Also contains sulfometuron and chlorsulfuron)	352-TII (ester)	39.5	Ground/Aerial – WDG	0.284	1	**0.284**

Table 3.1. Proposed Application Rates for 29 Products Containing Aminocyclopyrachlor						
Product	**EPA File Symbol (a.i. form)**	**% a.e.**	**Application Method & Formulation Type[1]**	**Maximum Single Application Rate (lb a.e./acre)**	**Maximum Number of Applications/Year[2] (Application Interval)**	**Maximum Application Rate/Year (lb a.e./acre)**
DuPont™ DPX-Q2B38 Herbicide (Also contains metsulfuron and imazapyr)	352-TIO (ester)	26.9	Ground/Aerial – WDG	0.269	1	0.269
DuPont™ DPX-Q2B39 Herbicide (Also contains metsulfuron)	352-TON (ester)	53.6	Ground/Aerial – WDG	0.268	1	0.268
DuPont™ DPX-QKJ02 Herbicide (Also contains chlorsulfuron)	352-TOR (ester)	53.6	Ground/Aerial – WDG	0.268	1	0.268
Turf: Professional Use Products						
DuPont™ DPX-KJM44 80XP Turf Herbicide	352-TOE (ester)	75	Ground – WDG	0.094	3 (14 days)	0.282
DuPont™ DPX-MAT28 240SL Turf Herbicide	352-TOG (salt)	*	Ground – SC	0.094	3 (14 days)	0.282
DuPont™ DPX-MAT28 50SG Turf Herbicide	352-TOU (acid)	50	Ground – WDG	0.094	3 (14 days)	0.282
DuPont™ DPX-KJM44 0.064G Turf Herbicide + Fertilizer	352-TOT (ester)	0.06	Ground – G	0.108	3 (30 days)	**0.324**
DuPont™ DPX-KJM44 0.053G Turf Herbicide + Fertilizer	352-TOI (ester)	0.05	Ground – G	0.100	3 (30 days)	0.300
DuPont™ DPX-KJM44 0.032G Turf Herbicide + Fertilizer	352-TOO (ester)	0.03	Ground – G	0.096	3 (30 days)	0.288
DuPont™ DPX-MAT28 0.06G Turf Herbicide + Fertilizer	352-IRE (acid)	0.06	Ground – G	0.108	3 (30 days)	**0.324**
DuPont™ DPX-MAT28 0.05G Turf Herbicide + Fertilizer	352-IRG (acid)	0.05	Ground – G	0.100	3 (30 days)	0.300
DuPont™ DPX-MAT28 0.03G Turf Herbicide + Fertilizer	352-IRU (acid)	0.03	Ground – G	0.090	3 (30 days)	0.270
Turf: Consumer Use Products						
DuPont™ DPX-MAT28 0.068G Lawn Herbicide + Fertilizer	352-IRL (acid)	0.068	Ground – G	0.075	2 (42 days)	0.150

Table 3.1. Proposed Application Rates for 29 Products Containing Aminocyclopyrachlor						
Product	**EPA File Symbol (a.i. form)**	**% a.e.**	**Application Method & Formulation Type[1]**	**Maximum Single Application Rate (lb a.e./acre)**	**Maximum Number of Applications/Year[2] (Application Interval)**	**Maximum Application Rate/Year (lb a.e./acre)**
DuPont™ DPX-KJM44 0.073G Lawn Herbicide + Fertilizer	352-INN (ester)	0.069	Ground – G	0.075	2 (42 days)	0.150
DuPont™ DPX-KJM44 0.065G Lawn Herbicide + Fertilizer	352-INR (ester)	0.061	Ground – G	0.075	2 (42 days)	0.150
DuPont™ DPX-KJM44 0.059G Lawn Herbicide + Fertilizer	352-INE (ester)	0.055	Ground – G	0.075	2 (42 days)	0.150
DuPont™ DPX-KJM44 0.053G Lawn Herbicide + Fertilizer	352-ING (ester)	0.05	Ground – G	0.075	2 (42 days)	0.150
DuPont™ DPX-KJM44 0.049G Lawn Herbicide + Fertilizer	352-INU (ester)	0.046	Ground – G	0.050	2 (42 days)	0.100
DuPont™ DPX-KJM44 0.039G Lawn Herbicide + Fertilizer	352-INL (ester)	0.037	Ground – G	0.050	2 (42 days)	0.100
DuPont™ DPX-KJM44 0.037G Lawn Herbicide + Fertilizer	352-INA (ester)	0.035	Ground – G	0.038	2 (42 days)	0.076
DuPont™ DPX-KJM44 0.033G Lawn Herbicide + Fertilizer	352-INT (ester)	0.031	Ground – G	0.038	2 (42 days)	0.076
DuPont™ DPX-KJM44 0.03G Lawn Herbicide + Fertilizer	352-INI (ester)	0.028	Ground – G	0.038	2 (42 days)	0.076
DuPont™ DPX-KJM44 0.027G Lawn Herbicide + Fertilizer	352-INO (ester)	0.025	Ground – G	0.038	2 (42 days)	0.076
DuPont™ DPX-KJM44 0.024G Lawn Herbicide + Fertilizer	352-IRN (ester)	0.023	Ground – G	0.025	2 (42 days)	0.050
DuPont™ DPX-KJM44 0.02G Lawn Herbicide + Fertilizer	352-IRR (ester)	0.018	Ground – G	0.025	2 (42 days)	0.050

[1]WDG = water dispersible granule; SC = soluble concentrate; G = granule.
[2]If not specified on label, number of applications may have been calculated based on maximum single application rate and maximum annual application rate.
*Registrant provided the amount of aminocyclopyrachlor acid (2 lb/gallon) rather than a percentage. Without either the weight of a given amount of formulation or the density of the formulation, it is not possible to determine the % a.e.
Maximum use scenarios modeled in this assessment are denoted by bold-face type.

3.2 Exposure Assessment

3.2.1 Environmental Fate and Transport Characterization

Environmental fate properties for aminocyclopyrachlor acid (DPX-MAT28) and the end-use products aminocyclopyrachlor methyl ester (DPX-KJM44) and aminocyclopyrachlor potassium salt are listed separately in **Tables 3.2, 3.3,** and **3.4,** respectively.

Aminocyclopyrachlor's major route of degradation is aqueous photolysis. The compound is expected to degrade with a half-life of 1.2 days in natural (pH 6.2) water and 7.8 days in pH 4 buffer solution. Aminocyclopyrachlor is stable to hydrolysis at pH 4, 7, and 9. Aminocyclopyrachlor is expected to be highly mobile to mobile. It is non-volatile (4.9×10^{-6} Pa. at 25°C; 3.7×10^{-8} mm Hg; MRID 475598-18 with $K_H = 3.47 \times 10^{-12}$ atm-m^3/mol; MRID 475598-20) and highly soluble (2810 mg/L at 20°C; MRID 475598-16) in water. Therefore, dissipation of aminocyclopyrachlor from the application site is expected to occur predominantly via aqueous photolysis, runoff, and leaching. Aminocyclopyrachlor was detected at soil depths of 70 – 90 cm at 365 days (MRID 475751-02), which indicates that leaching of residues into ground water may occur. Additionally, off-site movement of aminocyclopyrachlor is expected through spray drift from aerial and ground spray.

Table 3.2. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Acid		
Parameter [Guideline #]	**Value**	**MRID(s)**
Hydrolysis [161-1]	pH 4: $t_{1/2}$ = stable @ 50°C pH 7: $t_{1/2}$ = stable @ 50°C pH 9: $t_{1/2}$ = stable @ 50°C Observed DT_{50} > 5 days	475602-10
Aqueous Photolysis [161-2]	pH 4 buffer: $t_{1/2}$ = 7.8 days @ 20°C Observed DT_{50} ~ 168 days Natural Water (pH = 6.2): $t_{1/2}$ = 1.4 days @ 20°C Observed DT_{50} ~ 29 days **Transformation products**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – maximum 16.1% of the applied found only in pH 4 buffer. Degradate found increasing over time. 2. 4-Cyano-2-cyclopropyl-1H-imidazole-5-carboxylic acid (IN-QFH57) – maximum 13.8% of the applied in pH 4 buffer. Degradate found increasing over time. Maximum 33.1% of the applied in natural water (pH = 6.2). 3. Cyclopropanecarboxylic acid (IN-V0977) - maximum 12.4% of the applied in pH 4 buffer. Maximum 14.6% of the applied in natural water (pH = 6.2). Degradate increasing over time especially in natural water.	475602-11

Table 3.2. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Acid		
Parameter [Guideline #]	Value	MRID(s)
	4. Cyclopropanecarboximidamide (IN-YY905) - maximum 8.0% of the applied in pH 4 buffer. Maximum 11.7% of the applied in natural water (pH = 6.2). Degradate increasing over time in both systems.	
Soil Photolysis [161-3]	$t_{1/2}$ = 129 days @ 20°C Observed DT_{50} > 15 days **Transformation products:**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – maximum 4.9% of the applied found at 7 days (15 day study duration). 2. Non-extractable Residues – maximum 17.2% of the applied found at 15 days (15 day study duration).	475602-13
Aerobic Aquatic Metabolism [162-4]	Sand-Water: Observed DT_{50} > 100 days (W, S, TS) [1] Silt-loam-Water: Observed DT_{50} > 100 days (W, S, TS) **Transformation products**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – For Sand-Water: maximum 2.3% in water fraction, 1.0% in sediment fraction, 2.3% in total system. For Silt-Loam-Water: maximum 2.4% in water fraction, 1.2% in sediment fraction, 2.4% in total system. Note: Analysis of the test substance standard showed a small amount of IN-LXT69; therefore, it appears likely that the maximum percent of applied dose at Day 0 is a contaminant and not a transformation product. 2. Carbon Dioxide: – For Sand-Water: maximum 0.70% of the applied at 100 days (100 day study duration). For Silt-Loam-Water: maximum 0.20% of the applied at 100 days (100 day study duration). CO_2 increasing throughout study. 3. Non-Extractables – For Sand-Water: maximum 6.5% of the applied at 100 days (100 day study duration). For Silt-Loam-Water: maximum 11.1% of the applied at 100 days (100 day study duration). CO_2 increasing throughout study.	475602-16
Anaerobic Aquatic Metabolism [162-3]	Total System: $t_{1/2}$ = 1733 days (stable) Observed DT_{50} > 120 days Observed DT_{50} > 365 days (W ,S, TS) **Transformation products**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) –	475602-17

Table 3.2. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Acid		
Parameter [Guideline #]	Value	MRID(s)
	maximum 2.2% in water fraction, 1.0% in sediment fraction, 2.2% in total system. 2. Carbon Dioxide: – For Sand-Water: maximum 0.70% of the applied at 100 days (100 day study duration). For Silt-Loam-Water: maximum 0.20% of the applied at 100 days (100 day study duration). CO_2 increasing throughout study. 3. Non-Extractables: maximum 17.1% of the applied at 180 days (365 day study duration).	
Aerobic Soil Metabolism [162-1]	Sassafras: $t_{1/2}$ = 315 days Observed DT_{50} ~ 310 days **Transformation products**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – For Sassafras soil, maximum 2.9% of the applied at 3 days (260 day study duration). 2. Carbon Dioxide: – For Sassafras soil: maximum 23.1% of the applied at 360 days (360 day study duration). CO_2 increasing throughout study. 3. Non-Extractables: – For Sassafras soil: maximum 24.4% of the applied at 300 days (360 day study duration).	475602-14
	Nambsheim: $t_{1/2}$ = 433 days (non-linear) Observed DT_{50} > 120 days Tama: $t_{1/2}$ = 114 days Observed DT_{50} ~ 110 days Drummer: $t_{1/2}$ = 126 days Observed DT_{50} ~ 110 days **Transformation products**: 1. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – For Nambsheim soil, maximum 4.0% of the applied at 0 days (120 day study duration). For Tama soil, maximum 4.2% of the applied at 0 days (120 day study duration). For Drummer soil, maximum 6.4% of the applied at 0 days (120 day study duration). 2. Non-Extractables: For Nambsheim soil, maximum 13.0% of the applied at 120 days (120 day study duration). For Tama soil, maximum 43.2% of the applied at 120 days (120 day study duration). For Drummer soil, maximum 39.3% of the applied at 120 days (120 day study duration). Sorption increasing throughout study.	475602-21

Table 3.2. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Acid		
Parameter [Guideline #]	**Value**	**MRID(s)**
Anaerobic Soil Metabolism [162-2]	Total System: $t_{1/2}$ = 6932 days (stable) Observed DT_{50} > 365 days	475602-15
Adsorption/ Desorption (K_d and K_{oc} in L Kg^{-1}) [163-1]	**Soil type: Drummer Clay Loam** Adsorption K_d: 0.98 Adsorption K_{oc}: 26 Organic Carbon (%) = 3.8 Clay (%) = 31 Freundlich adsorption K_f: 0.941 Freundlich adsorption K_{foc}: 24.8 1/n: 1.0007 Desorption Constants: Not Determined **Soil type: California Loam** Adsorption K_d: 0.03 Adsorption K_{oc}: 5.2 Organic Carbon (%) = 0.5 Clay (%) = 15 Freundlich adsorption K_f: 0.004 Freundlich adsorption K_{foc}: 0.8 1/n: 0.5167 Desorption Constants: Not Determined **Soil type: Nambsheim Sandy Loam** Adsorption K_d: 0.03 Adsorption K_{oc}: 2.0 Organic Carbon (%) = 1.3 Clay (%) = 7 Freundlich adsorption K_f: 0.016 Freundlich adsorption K_{foc}: 1.2 1/n: 0.0871 Desorption Constants: Not Determined **Soil type: Lleida Silty Clay** Adsorption K_d: 0.05 Adsorption K_{oc}: 3.2 Organic Carbon (%) = 1.6 Clay (%) = 45 Freundlich adsorption K_f: 0.066 Freundlich adsorption K_{foc}: 4.1 1/n: 1.046 Desorption Constants: Not Determined **Soil type: Sassafras #16 Sandy Loam** Adsorption K_d: 0.27 Adsorption K_{oc}: 22 Organic Carbon (%) = 1.2 Clay (%) = 13	475602-19

Table 3.2. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Acid

Parameter [Guideline #]	Value	MRID(s)
	Freundlich adsorption K_f: 0.217 Freundlich adsorption K_{foc}: 18.1 1/n: 0.9163 Desorption Constants: Not Determined	
Terrestrial Field Dissipation [164-1]	**Canada Bare Soil: 0-5 cm.** Dissipation $t_{1/2}$ = 126 days Observed DT_{50} ~ 31 days No major transformation products detected.	475602-24
	California Bare Soil: Possible leacher – detected at 70-90 cm. No major transformation products detected.	475751-02
	Georgia turf: Grass Dissipation $t_{1/2}$ = 22.4 days Observed DT_{50} ~ 4.3 days **0-5 cm:** Dissipation $t_{1/2}$ = 27 days Observed DT_{50} ~ 10.8 days Possible leacher – detected at 15-30 cm.	475602-22
	Canada turf: Grass. Dissipation $t_{1/2}$ = 24.2 days Observed DT_{50} ~ 5.4 days **0-5 cm:** Dissipation $t_{1/2}$ = 38 days Observed DT_{50} ~ 21 days Possible leacher – detected at 50-70 cm. **Transformation product detected**: 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) **Canada turf: Grass.** Dissipation $t_{1/2}$ = 7.2 days Observed DT_{50} ~ 3.3 days	475602-23

[1]W = Water; S = Sediment, TS = Total System (sum of concentrations in water and sediment extracts)

Table 3.3. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Methyl Ester		
Parameter [Guideline #]	**Value**	**MRID(s)**
Hydrolysis [161-1]	$t_{½}$ = 26.9 days @ 40°C at pH 4 $t_{½}$ = 51.7 days @ 20°C at pH 7 $t_{½}$ = 0.3 days @ 20°C at pH 9	478357-01
Aqueous Photolysis [161-2]	<u>pH 4 buffer:</u> $t_{1/2}$ = 4.1 days Observed DT_{50} > 2 days **Degradates**: 1. 6-Amino-5-chloro-2-cyclopropylpyrimidine-4-carboxylic acid (parent aminocyclopyrachlor) – maximum 3.3% of the applied at 8 hours (2 day study duration). 2. 5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine (IN-LXT69) – maximum 9.3% of the applied at 2 days (2 day study duration). 3. Cyclopropanecarboxamide (IN-Q3007) – maximum 7.8% of the applied at 2 days (2 day study duration).	475602-12
Aerobic Soil Metabolism [162-1]	Half-life could not be accurately calculated because of the rapid transformation to the aminocyclopyrachlor acid (< 1% of the applied remaining after 3 days).	475602-14
Terrestrial Field Dissipation [164-1]	**<u>Canada Bare Soil:</u> 0-5 cm.** Dissipation $t_{1/2}$ = 7.7 days Observed DT_{50} ~ 4.6 days	475602-24
	<u>CA Bare Soil:</u> 0-5 cm. Dissipation $t_{1/2}$ = 3.8 days Observed DT_{50} ~ 1.2 days	475751-02
	<u>GA turf:</u> Grass. Dissipation $t_{1/2}$ = 1.3 days Observed DT_{50} ~ 1 day **<u>0-5 cm:</u>** Dissipation $t_{1/2}$ = 5.5 days Observed DT_{50} ~ 1 day	475602-22
	<u>Canada turf:</u> Grass. Dissipation $t_{1/2}$ = 5.6 days Observed DT_{50} ~ 1 day **<u>0-5 cm:</u>** Dissipation $t_{1/2}$ = 48 days Observed DT_{50} ~ 1 day	475602-23

Table 3.4. Summary of Environmental Fate and Transport Properties of Aminocyclopyrachlor Potassium Salt		
Parameter [Guideline #]	**Value**	**MRID(s)**
Dissociation Constant Study [OPPTS 830.7370]	pKa = 4.63 $\pm$ 0.14 @ 20 $\pm$ 1°C within 2 to 7 minutes Compares favorably to pKa = 4.65 $\pm$ 0.04 @ 20 $\pm$ 1°C for aminocyclopyrachlor acid (parent).	478909-01

Mobility

Based on the batch equilibrium data, aminocyclopyrachlor displays an affinity to organic carbon. Adsorption of aminocyclopyrachlor (K_{oc} = 2 to 26 mL/g_{oc}; MRID 475602-19) is characterized as being highly mobile to mobile in the test soils (FAO Classification; U.S. EPA, 2006). Desorption constants were not provided. However, 13 – 39% of non-extractable residues were found in an aerobic soil metabolism study (MRID 475602-21). Sufficient extraction methods were used and sorption increased throughout the study.

Aminocyclopyrachlor is non-volatile (4.9 x 10^{-6} Pa. at 25°C; 3.7 x 10^{-8} mm Hg; MRID 475598-18 and K_H = 3.47 x 10^{-12} atm-m^3/mol; MRID 475598-20) and highly soluble (2810 mg/L at 20°C; MRID 475598-16) in water. Therefore, dissipation of aminocyclopyrachlor is expected to occur predominantly via runoff and leaching. Aminocyclopyrachlor was detected at soil depths of 70 – 90 cm at 365 days (MRID: 475751-02), which indicates that leaching of residues into ground water may occur.

Degradation

Considering biodegradation, aminocyclopyrachlor is persistent in aerobic aquatic ($t_{1/2}$ not determined; observed DT_{50} > 100 days; MRID 475602-16) and aerobic terrestrial environments ($t_{1/2}$ = 315 days; MRID 475602-14). In addition, it is relatively stable in anaerobic aquatic ($t_{1/2}$ = 1733 days; MRID 475602-17) and anaerobic terrestrial environments ($t_{1/2}$ = 6932 days; MRID 47560215).

Considering abiotic degradation, aqueous photolysis (MRID 475602-11) is the major route of degradation and aminocyclopyrachlor is expected to degrade with a half-life of 1.2 days in shallow, clear, and well-lit natural (pH 6.2) water bodies and 7.8 days in pH 4 buffer solution. However, it is slowly photolyzed on soil ($t_{1/2}$ = 129 days; MRID 475602-13). Aminocyclopyrachlor is stable to hydrolysis (MRID 475602-10) at pH 4, 7, and 9.

Dissipation occurred with half-lives ranging from 22 to 126 days in terrestrial field dissipation studies conducted in the continental United States and Canada (MRID 475751-02, 475602-22, 475602-23, and 475602-24).

Degradates of Concern

The major environmental degradates of aminocyclopyrachlor include IN-LXT69, IN-QFH57, IN-Q3007, IN-V0977, IN-YY905, CO_2 and an unidentified aqueous photoproduct (**Table 3.5**). Most of the major degradates formed under aqueous photolysis and were increasing in amount at study termination. Ecological risks were quantified for the parent aminocyclopyrachlor acid only due to lack of toxicity data for the degradates. ECOSAR was used to predict toxicity of the degradates to aquatic organisms (see **Section 5.2.3**), and because of the lack of submitted toxicity data, the total toxic residue (TTR) approach was explored. However, EECs were not calculated for degradates IN-LXT69 and IN-YY905 because the major degradation process of aminocyclopyrachlor (aqueous photolysis) was not a significant component of residue calculation in GENEEC (see **Section 5.2.3**). Structure activity relationships (SARs) were also used to predict the toxicity of the degradates to terrestrial organisms to determine what toxicity data is required for a comprehensive assessment. Using these approaches, potential risks to non-target organisms due to exposure to the degradates can be qualitatively described.

Table 3.5. Major Degradates of Aminocyclopyrachlor Acid

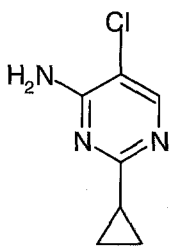
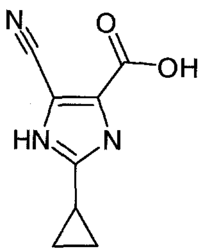
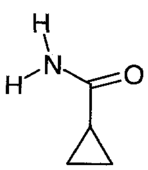
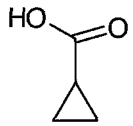
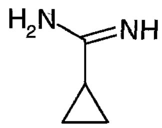
Name of Degradate and Structure	IUPAC Name	Maximum Detected (%)	Comments
Major degradates			
IN-LXT69 	5-Chloro-2-cyclopropyl-pyrimidin-4-ylamine	16.1	Aqueous Photolysis MRID 475602-11
IN-QFH57 	4-Cyano-2-cyclopropyl-1H-imidazole-5-carboxylic acid	33.1	Aqueous Photolysis MRID 475602-11
IN-Q3007 	Cyclopropanecarboxamide	24.4	Aqueous Photolysis MRID 475602-11

Table 3.5. Major Degradates of Aminocyclopyrachlor Acid			
Name of Degradate and Structure	IUPAC Name	Maximum Detected (%)	Comments
IN-V0977 	Cyclopropanecarboxylic acid	14.6	Aqueous Photolysis MRID 475602-11
IN-YY905 	Cyclopropanecarboximidamide	11.7	Aqueous Photolysis MRID 475602-11
CO_2 O=C=O	Carbon Dioxide	23.1	Aerobic Soil Met. MRID 475602-14
(unidentified)	(unidentified)	16.8	Aqueous Photolysis MRID 475602-11

3.2.2 Aquatic Exposure Estimates for Aminocyclopyrachlor

A Tier I screening-level surface water exposure for aquatic risk assessment was conducted for the Section 3 proposed new chemical registration. Modeled application rates represent the maximum use patterns of the proposed labels for non-crop and turf use. Pre- and post-emergent spray applications (aerial and ground spray for non-crop areas; ground spray only for turf) and granular applications (ground only for turf) are proposed (see **Table 3.1**). The aquatic exposure estimates presented in this assessment were based on the use of models as no surface and ground water monitoring data is available for aminocyclopyrachlor within the continental U.S. To simulate surface water exposure for the ecological risk assessment, the Tier I GENEEC2 model was used.

GENEEC2 Model Inputs for Aminocyclopyrachlor

The GENEEC (*GEN*eric *E*stimated *E*nvironmental *C*oncentration) model, a Tier I computer program, uses the soil/water partition coefficient and degradation kinetic data to estimate runoff from a ten hectare field into a one hectare by two meter deep "standard" pond. This first tier is designed as a coarse screen and estimates conservative pesticide concentrations in surface water from a few basic chemical parameters and pesticide label use and application information. Tier I is used to screen chemicals to determine which ones potentially pose sufficient risk to warrant higher level modeling.

GENEEC is a program to calculate acute as well as longer-term estimated environmental concentration (EEC) values. It considers reduction in dissolved pesticide concentration due to adsorption of pesticide to soil or sediment, incorporation, degradation in soil before washoff to a water body, direct deposition of spray drift into the water body, and degradation of the pesticide within the water body. It is designed to mimic a high-end PRZM-EXAMS simulation. Additional information on this and other models can be found at: http://www.epa.gov/oppefed1/models/water/index.htm.

The aquatic exposure is estimated for the maximum application pattern to a 10-ha field bordering a 1-ha pond, 2-m deep (20,000 m^3) with no outlet. Exposure estimates generated using this standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either smaller in size or have large drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the standard pond has no discharge. As watershed size increases beyond 10-ha, it becomes increasingly unlikely that the entire watershed is planted with a non-major single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

Table 3.6 summarizes the model input parameter values used in GENEEC2 to estimate aminocyclopyrachlor concentrations in aquatic systems for ecological risk assessment.

Table 3.6. GENEEC2 Input Parameters for Aminocyclopyrachlor Acid for Non-Crop and Turf Use

Parameter	Input Value	Data Source/Rationale[1]
Application Rate (lb a.e./acre)	0.284 0.108	U.S. EPA Reg. No. 352-TII (non-crop – parent) U.S. EPA Reg. No. 352-TOT (turf – parent)
Maximum Number of Applications/Year	1 3	U.S. EPA Reg. No. 352-TII (non-crop – parent) U.S. EPA Reg. No. 352-TOT (turf – parent)
Application Interval (days)	NA 30	U.S. EPA Reg. No. 352-TII (non-crop – parent) U.S. EPA Reg. No. 352-TOT (turf – parent)
K_{oc} Parent	12	Average Koc value: MRID 475602-19
Aerobic Soil Metabolism Half-life (days) Parent	373	Parent value represents the upper 90% confidence limit on the mean value (MRID 475602-14 and 475602-21).
Is the pesticide wetted-in?	No	Chemical not known to be activated by water
Method of Application	Aerial Ground	Spray Application: fine to medium droplet size; no spray zone/buffer (non-crop - parent) Spray Application: high boom height; fine droplet size (turf – parent)
Incorporation Depth (inches)	0	Broadcast Application

Table 3.6. GENEEC2 Input Parameters for Aminocyclopyrachlor Acid for Non-Crop and Turf Use		
Parameter	**Input Value**	**Data Source/Rationale[1]**
Solubility (ppm) Parent	2810	MRID 475598-16
Aerobic Aquatic Metabolism Half-life (days) Parent	0 (stable)	MRID 475602-16
Photolysis Half-life (days) Parent	7.8	MRID 475602-11
[1]Input Parameters were selected in accordance with the Guidance for Selecting Input Parameters (Version II) dated February 28, 2002 NA = Not Applicable		

The estimated environmental concentrations (EECs) for the parent aminocyclopyrachlor acid for non-crop and turf use are listed in **Table 3.7**. In general, aerial applications resulted in higher EECs compared to ground applications. Maximum concentrations are highlighted in bold. The GENEEC output files are listed in **Appendix A**.

Table 3.7. Estimated Environmental Concentrations (EECs) Resulting from Applications of Aminocyclopyrachlor for Proposed Uses							
Model	**Compound**	**Use**	**Method**	**Application Rate (interval between applications)**	**Peak EEC (µg/L)**	**21-Day EEC (µg/L)**	**60-Day EEC (µg/L)**
Surface Water (GENEEC2)	Aminocyclopyrachlor Acid	Non-Crop	Aerial	1 app @ 0.284 a.e./acre (NA)	**16.86**	**16.79**	**16.64**
			Ground	1 app @ 0.284 a.e./acre (NA)	16.47	16.40	16.26
		Turf	Ground (granule)	3 apps @ 0.108 a.e./acre (30 days)	16.82	16.75	16.60
Bold values denote maximum Estimated Environmental Concentrations (EECs) All applications are liquid unless otherwise noted. NA = Not Applicable							

Aquatic Exposure Monitoring and Field Data

Since aminocyclopyrachlor is a new active ingredient, no national-scale monitoring data were available for this chemical.

3.2.3 Terrestrial Wildlife Exposures

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals emphasizing a dietary exposure route for uptake of pesticide residues on vegetative matter and insects. Birds are used as surrogates for terrestrial-phase amphibians as well as reptiles. For exposure to terrestrial organisms, pesticide residues on food items are estimated based on the assumption that organisms are exposed to a single pesticide residue in a given exposure scenario. The residue estimates from spray applications are based on a nomogram by Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994) that correlated residue levels, based on application rate, on various terrestrial items immediately following application in the field. The "maximum" residue concentration, an upper bound defined by Fletcher *et al.* (1994), for each food group was derived from literature and tolerance data.

Dissipation of aminocyclopyrachlor residues on food items following single and multiple applications is predicted using a first-order residue degradation half-life with EFED's T-REX v1.4.1 model. T-REX assumes a default foliar dissipation half-life estimate of 35 days (Willis and McDowell, 1987). This half-life is used in lieu of aminocyclopyrachlor foliar dissipation data, which were not submitted by the registrant. The maximum predicted residues on avian and mammalian food items (dietary EECs) as a result of applications to non-crop areas are provided in **Table 3.8** and **3.9**. Application to non-crop areas, according to proposed label 352-TII, was chosen because it represents the scenario with the highest proposed maximum single and maximum annual application rates. Although aminocyclopyrachlor may be applied as a granule, proposed granular application rates are lower than proposed spray application rates. For this reason, the LD_{50}/ft^2 approach was not used.

The residues or EECs on food items may be compared directly with sub-acute dietary toxicity data or converted to an ingested whole-body dose (single oral dose). Single oral dose estimates represent, for many pesticides, an exposure scenario where absorption of the pesticide is maximized over a single ingestion event. Sub-acute dietary estimates provide for possible effects of the dietary matrix and more extended time of gut exposure to pesticide absorption across the gut. However, dietary exposure endpoints are limited in their utility because the current food ingestion estimates are uncertain and may not be directly comparable from laboratory conditions to field conditions. The EEC is converted to an oral dose by multiplying the EEC by the percentage of body weight consumed as estimated through allometric relationships. These consumption-weighted EECs (*i.e.,* EEC equivalent dose) are determined for each food source and body size for birds (20, 100, and 1000 g) and mammals (15, 35, and 1000 g). EEC equivalent doses for birds and mammals based on application to non-crop areas and turf are given in **Tables 3.8** and **3.9**, respectively. Example output from T-REX is included in **Appendix B**.

As predicted by HED (see **Section 5.2.3**), the degradate IN-V0977 (cyclopropanecarboxylic acid) may pose additional risks to birds and mammals. However, because toxicity data has not been submitted, EECs were not calculated.

Table 3.8. Avian Exposure Concentration Estimates for Aminocyclopyrachlor				
Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
(352-TII) Herbicide on Non-crop Areas 1 application at 0.284 lb a.e./acre				
Short grass	68.16	77.63	44.27	19.82
Tall grass	31.24	35.58	20.29	9.08
Broadleaf plants/small insects	38.34	43.67	24.90	11.15
Fruits/pods/seeds/large insects	4.26	4.85	2.77	1.24
Granivores	-	1.08	0.61	0.28

Table 3.9. Mammalian Exposure Concentration Estimates for Aminocyclopyrachlor				
Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (35 g)	Large (1000 g)
(352-TII) Herbicide on Non-crop Areas 1 application at 0.284 lb a.e./acre				
Short grass	68.16	64.99	44.91	10.41
Tall grass	31.24	29.78	20.59	4.77
Broadleaf plants/small insects	38.34	36.55	25.26	5.86
Fruits/pods/seeds/large insects	4.26	4.06	2.81	0.65
Granivores	-	0.90	0.62	0.14

3.2.4 Terrestrial and Semi-Aquatic Plant Exposures

Terrestrial and semi-aquatic plants may be exposed to pesticides from runoff, spray drift, or volatilization. Semi-aquatic plants are those that inhabit low-lying wet areas that may be dry at certain times of the year. The runoff scenario in TerrPlant v1.2.2 is: (1) based on a pesticide's water solubility and the amount of pesticide present on the soil surface and its top one centimeter, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channel runoff" (10 acres to a distant low-lying acre) for semi-aquatic or wetland areas, and (4) based on runoff values of 1, 2, and 5% for water solubility values of <10, 10-100, and >100 ppm, respectively. Spray drift is assumed as (1) 1% for ground application, (2) 5% for aerial, airblast, forced air, and spray chemigation applications, and (3) 0% for granular applications. Currently, EFED derives plant exposure concentrations from a single maximum application rate only. Exposure through volatilization is not accounted for in this baseline assessment; however, based on the low vapor pressure, it is not expected to be a significant route of exposure. EECs for turf and non-crop areas are presented in **Table 3.10**. Example of TerrPlant output is provided in **Appendix C.**

Table 3.10. EECs for Terrestrial and Semi-aquatic Plants for Aerial and/or Ground Application to Turf and Non-crop Areas				
	Turf (0.108 lb a.e./acre)	Turf (0.094 lb a.e./acre)	Non-crop Areas (0.284 lb a.e./acre)	
Description	Ground (granule)	Ground (spray)	Ground (spray)	Aerial (spray)
Runoff to dry areas	0.0054	0.0047	0.0142	0.0142

Runoff to semi-aquatic areas	0.054	0.047	0.142	0.142
Spray drift	0	0.00094	0.00284	0.0142
Total for dry areas	0.0054	0.00564	0.01704	0.0284
Total for semi-aquatic areas	0.054	0.04794	0.14484	0.1562

4 Ecological Effects Analysis

A search of the public ECOTOX database (http://cfpub.epa.gov/ecotox) on October 30, 2009 did not yield any aquatic or terrestrial open literature studies for aminocyclopyrachlor. This result is to be expected as aminocyclopyrachlor is a new chemical. Therefore, only studies submitted by the registrant were evaluated to determine the effects of aminocyclopyrachlor on non-target organisms. The Ecological Incident Information System (EIIS) was also reviewed to provide a refined characterization of the ecological effects. As expected, no incidents were found for aminocyclopyrachlor; however, several incidents were found involving the pyridine carboxylic acids (see **Section 4.4**).

4.1 Aquatic Effects Summary

Studies that evaluated the effects of the acid (DPX-MAT28) and the effects of the ester (DPX-KJM44) were submitted for aquatic flora and fauna. Toxicity classifications for those studies requiring them ranged from practically non-toxic to slightly toxic. The acute freshwater fish and daphnid studies showed that the ester may be more toxic than the acid. Because the submitted data on the ester were limited, there are some uncertainties regarding the toxicity of the ester (see **Section 4.3**).

4.1.1 Toxicity Effects on Fish

Two definitive studies that evaluated the acute effects of the acid to rainbow trout (MRID 475601-23) and bluegill sunfish (MRID 475601-24) were submitted. Measured test concentrations ranged from 7.6 to 122 mg a.e./L for the rainbow trout and 7.5 to 120 mg a.e./L for the bluegill sunfish. There was a complete lack of mortality and sublethal effects in both of the studies; both studies classify aminocyclopyrachlor as practically non-toxic and satisfy the guideline requirements for an acute freshwater fish study. The rainbow trout 96-hr LC_{50} was >122 mg a.e./L and the NOAEC was 122 mg a.e./L. The bluegill sunfish 96-hr LC_{50} was >120 mg a.e./L and the NOAEC was 120 mg a.e./L. A definitive study that evaluated the acute effects of the ester to rainbow trout (MRID 475602-06) was submitted. The 96-hr LC_{50} was 13 mg a.e./L and the NOAEC was 8.1 mg a.e./L. Lethargy was the sublethal effect observed in the two highest test concentrations. Based on these results, the ester would be classified as slightly toxic to freshwater fish. The guideline requirements are satisfied by this study. Results of the three acute freshwater fish studies are summarized in **Table 4.1**.

Table 4.1. Toxic Effects in Freshwater Fish Due to Acute Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value	Toxicity Classification	Study Classification	MRID #
850.1075 acid (92.2%)	Rainbow trout (*Oncorhynchus mykiss*)	96-hr LC_{50}: >122 mg a.e./L NOAEC: 122 mg a.e./L (no effects)	Practically Non-toxic	Acceptable	475601-23

850.1075 acid (92.2%)	Bluegill sunfish (*Lepomis macrochirus*)	96-hr LC_{50}: >120 mg a.e./L NOAEC: 120 mg a.e./L (no effects)	Practically Non-toxic	Acceptable	475601-24
850.1075 ester (90.9% a.e.)	Rainbow trout (*Oncorhynchus mykiss*)	96-hr LC_{50}: 13 mg a.e./L* NOAEC: 8.1 mg a.e./L (based on mortality and sublethal effects [lethargy])	Slightly Toxic	Acceptable	475602-06
*Denotes value used for RQ calculation.					

A limit test study was submitted that evaluated the acute effects of the acid to an estuarine/marine fish, sheepshead minnow (MRID 475601-25). There was a complete lack of mortality and sublethal effects; the 96-hr LC_{50} and 96-hr EC_{50} were >129 mg a.e./L and the NOAEC was 129 mg a.e./L. The results of the study classify the acid as practically non-toxic to estuarine/marine fish. Guideline requirements for an acute study on estuarine/marine fish are satisfied. Results of this study are summarized in **Table 4.2**.

Table 4.2. Toxic Effects in Estuarine/Marine Fish Due to Acute Exposure to Aminocyclopyrachlor					
Study Type	**Species**	**Toxicity Value**	**Toxicity Classification**	**Study Classification**	**MRID #**
850.1075 acid (92.2%)	Sheepshead minnow (*Cyprinodon variegatus*)	96-hr LC_{50}: >129 mg a.e./L NOAEC: 129 mg a.e./L (no effects)	Practically Non-toxic	Acceptable	475601-25

A 90-day chronic toxicity test was submitted that evaluated the effects of the acid on the early-life stage of rainbow trout (MRID 475601-30) under flow-through conditions. Measured test concentrations were between 0.69 and 11 mg a.e./L. There were no treatment-related effects on hatching success, time to hatch, post-hatch survival, time to swim-up, or growth at any treatment level. The 90-day LC/EC_{50} for all endpoints was >11 mg a.e./L, and the NOAEC and LOAEC were 11 and >11 mg a.e./L, respectively. This study satisfies the guideline requirement for an early-life stage study with freshwater fish. The results are summarized in **Table 4.3**.

Table 4.3. Toxic Effects in Freshwater Fish Due to Chronic Exposure to Aminocyclopyrachlor					
Study Type	**Species**	**Toxicity Value**	**Most Sensitive Endpoint**	**Study Classification**	**MRID #**
850.1400 acid (92.2%)	Rainbow trout (*Oncorhynchus mykiss*)	NOAEC: 11 mg a.e./L LOAEC: >11 mg a.e./L	No Effects	Acceptable	475601-30

4.1.2 Toxicity Effects on Invertebrates

A study was submitted that evaluated the acute effects of the acid on water fleas (MRID 475601-26). Measured test concentrations were between 3.7 and 120 mg a.e./L. The 48-hour LC_{50} was 39.7 mg a.e./L. Sublethal effects were observed in all but the lowest test concentration; the 48-hr NOAEC based on mortality and sublethal effects (lethargy) was 3.7 mg a.e./L. Based on these results, the acid is classified as slightly toxic to freshwater invertebrates. This study satisfies the guideline requirements for an acute toxicity study with freshwater invertebrates. A study was also submitted that evaluated the acute effects of the ester on water fleas (MRID 475602-07). Measured test concentrations were between 0.92 and 30 mg a.e./L. The 48-hour LC_{50} was 19.9 mg a.e./L. Sublethal effects were seen at all but the lowest test concentration; the 48-hr NOAEC based on mortality and sublethal effects (lethargy and surfacing) was 0.92 mg a.e./L. These results classify the ester as slightly toxic to freshwater invertebrates. This study satisfies the guideline requirements for an acute toxicity study with freshwater invertebrates. The results of these two studies are summarized in **Table 4.4**.

Table 4.4. Toxic Effects in Freshwater Invertebrates Due to Acute Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value	Toxicity Classification	Study Classification	MRID #
850.1010 acid (92.2%)	Water flea (*Daphnia magna*)	48-hr LC_{50}: 39.7 mg a.e./L NOAEC: 3.7 mg a.e./L (based on mortality and sublethal effects [lethargy])	Slightly Toxic	Acceptable	475601-26
850.1010 ester (90.9% a.e.)	Water flea (*Daphnia magna*)	48-hr LC_{50}: 19.9 mg a.e./L* NOAEC: 0.92 mg a.e./L (based on mortality and sublethal effects [lethargy and surfacing])	Slightly Toxic	Acceptable	475602-07
*denotes values used to calculate RQs					

Two studies were submitted that evaluated the effects of the acid on estuarine/marine invertebrates. An oyster shell deposition test using the Eastern oyster (MRID 475601-27) produced an IC_{50} of >118 mg a.e./L. A significant reduction in shell deposition was only observed in the highest test concentration; the NOAEC was 67 mg a.e./L. These results classify the acid as practically non-toxic to estuarine/marine mollusks, and the study satisfies guideline requirements. A mysid shrimp acute toxicity test (MRID 4752601-28) produced a 96-hr LC_{50} that was >122 mg a.e./L. Because there were no significant treatment-related effects, the NOAEC for this study was 122 mg a.e./L. The acid is classified as practically non-toxic to estuarine/marine invertebrates. Guideline requirements are satisfied by this study. Results of these two studies are summarized in **Table 4.5**.

Table 4.5. Toxic Effects in Estuarine/Marine Invertebrates Due to Acute Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value	Toxicity Classification	Study Classification	MRID #
850.1025 acid (92.2%)	Eastern oyster (*Crassostrea virginica*)	96-hr LC_{50}: >118 mg a.e./L 96-hr EC_{50}: >118 mg a.e./L NOAEC: 67 mg a.e./L	Practically Non-toxic	Acceptable	475601-27
850.1035 acid (92.2%)	Mysid shrimp (*Americamysis bahia*)	96-hr LC_{50}: >122 mg a.e./L NOAEC: 122 mg a.e./L (no effects)	Practically Non-toxic	Acceptable	4752601-28

A 21-day chronic toxicity study was submitted that evaluated the effects of the acid on water fleas (MRID 475601-29) under static renewal conditions. Measured test concentrations were between 0.37 and 6.0 mg a.e./L. The 21-day LC_{50} for adult mortality was >6.0 mg a.e./L. However, non dose-response mortalities were observed in the 0.37, 0.73, and 1.5 mg a.e./L of

40%, 30, and 40%, respectively. Therefore, a NOAEC could not be established. This study is scientifically sound but is classified as supplemental. Due to the high mortality observed in the first three treatment levels, the resulting toxicity values do not provide a reliable estimate of the chronic toxicity to water fleas. Additionally, immobility was observed in all treatment levels of the second range-finding test; however, data for the range-finding tests were not provided. Finally, in the acute water flea study (MRID 475601-26), sublethal effects and mortality provided a NOAEC of 3.7 mg a.e./L; this comparison suggests a possible issue with the health of the test organisms in this chronic study. The results of this study are summarized in **Table 4.6.**

Table 4.6. Toxic Effects in Freshwater Invertebrates Due to Chronic Exposure to Aminocyclopyrachlor					
Study Type	**Species**	**Toxicity Value (ppb)**	**Most Sensitive Endpoint**	**Study Classification**	**MRID #**
850.1300 acid (92.2%)	Water flea (*Daphnia magna*)	NOAEC: N/A (less than the lowest concentration tested) LOAEC: 0.37 mg a.e./L	Mortality	Supplemental	475601-29

4.1.3 Toxicity Effects on Plants

Four studies were submitted that evaluated the effects of the acid on non-vascular plants. A 96-hour study was done with freshwater blue-green algae (MRID 475602-01). Cell density, growth rate, and biomass were the endpoints affected with biomass being the most sensitive. The NOAEC and EC_{50} values for biomass were 1.11 and 7.4 mg a.e./L, respectively. There were no differences in cell morphology between the control and treatment groups, but flocculation and aggregation of cells was observed in all treatment levels but the highest. A 96-hour study was done with the marine diatom (MRID 475602-02). There were extremely low or no inhibitions for all endpoints, which resulted in a NOAEC and EC_{50} value of 120 and >120 mg a.e./L, respectively. There were no differences in cell morphology between the control and treatment groups, and flocculation, aggregation, and adherence were not observed in any group. A 72-hour study was conducted for freshwater green algae (MRID 475602-03). No endpoint was inhibited by more than 50%; therefore, the EC_{50} value was determined to be >120 mg a.e./L. The cell density and biomass endpoints shared NOAEC and EC_{05} values of 15.3 and 62 mg a.e./L. There were no differences in cell morphology between the control and treatment groups, and flocculation, aggregation, and adherence did not occur in any group. A 96-hour study was conducted on freshwater diatom (MRID 475602-04), and high inhibitions (96-99%) were reported for all three endpoints. Biomass was the most sensitive endpoint with an EC_{50} of 38 mg a.e./L and a NOAEC of 14 mg a.e./L. There were no differences in cell morphology between the control and the treatment groups. There was no evidence of flocculation, aggregation, or adherence in any group. Guideline requirements are satisfied by all four studies (freshwater green algae study satisfies Tier I requirements only), and they are summarized in **Table 4.7.**

Table 4.7. Toxic Effects in Non-vascular Plants Due to Exposure to Aminocyclopyrachlor				
Study Type	**Species**	**Toxicity Value**	**Study Classification**	**MRID #**
850.5400 acid (92.2%)	Blue-green algae (*Anabaena flos-aquae*)	96 hr EC_{50}: 7.4 mg a.e./L NOAEC: 1.11 mg a.e./L (biomass)	Acceptable	475602-01

850.5400 acid (92.2%)	Marine diatom (*Skeletonema costatum*)	96 hr EC_{50}: >120 mg a.e./L NOAEC: 120 mg a.e./L (no effects)	Acceptable	475602-02
850.5400 (Tier I) acid (92.2%)	Green algae (*Pseudokirchneriella subcapitata*)	72 hr EC_{50}: >120 mg a.e./L 72 hr EC_{05}: 62 mg a.e./L NOAEC: 15.3 mg a.e./L (cell density and biomass)	Acceptable	475602-03
850.5400 acid (92.2%)	Freshwater diatom (*Navicula pelliculosa*)	96 hr EC_{50}: 38 mg a.e./L NOAEC: 14 mg a.e./L (biomass)	Acceptable	475602-04

A 7-day study was submitted that evaluated the effects of the acid on a vascular plant, duckweed (MRID 475601-34). None of the endpoints were inhibited by more than 50%; therefore, the EC_{50} values for frond number, frond number yield, biomass, and growth rate based on frond number were >122 mg a.e./L. Frond number and frond number yield were the most sensitive endpoints with EC_{05} values of 21 mg a.e./L with NOAEC values of 3.75 mg a.e./L. By test termination, there were isolated cases of chlorosis, necrosis, and dead fronds observed in all but the highest test level. In the highest test level, some or all of the fronds were small, curled, and/or some or all of the colonies were coagulating (not breaking apart).This study satisfies guideline requirements for a freshwater vascular plant toxicity test and is summarized in **Table 4.8**.

Table 4.8. Toxic Effects in Vascular Plants Due to Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value (ppb)	Study Classification	MRID #
850.4400 acid (92.2%)	Duckweed (*Lemna gibba*)	7-day EC_{50}: >122 mg a.e./L 7-day EC_{05}: 21 mg a.e./L NOAEC: 3.75 mg a.e./L (frond number and frond number yield)	Acceptable	475601-34

4.2 Terrestrial Effects Summary

Thirteen studies were submitted that evaluated the effects of aminocyclopyrachlor to terrestrial non-target organisms. The plant studies were conducted using a technical end-use product (TEP), which was an ester formulation. Similarly, one of the avian acute oral studies and one of the mammalian acute oral studies were conducted using the ester. For the most part, aminocyclopyrachlor was practically non-toxic to birds, mammals, and invertebrates. As expected since aminocyclopyrachlor is an herbicide, seedling emergence and vegetative vigor toxicity was affected in the plant studies.

4.2.1 Toxicity Effects on Birds

Two acute oral toxicity studies were submitted for bobwhite quail. The study with the acid (MRID 475601-18) showed a complete lack of mortality and sublethal effects. There were no signs of toxicity, effects on body weight, or changes in food consumption between the control and treatment groups. The 14-day LD_{50} was >2075 mg a.e./kg-bw, and the NOAEL was 2075 mg a.e./kg-bw. The study classifies the acid as practically non-toxic and satisfies guideline requirements for an acute oral toxicity test for an upland game bird or waterfowl species. The study with the ester (MRID 475602-05) did not show any mortality. There were no clinical signs of toxicity, effects on food consumption, or change in female body weight; however, there was a significant change in male body weight in the three highest treatment groups. The 14-day LD_{50} was >2045 mg a.e./kg-bw, and the NOAEL was 442 mg a.e./kg-bw. This study classifies the ester as practically non-toxic, and guideline requirements are satisfied by this study.

Acute dietary toxicity studies were submitted for each of the bobwhite quail and mallard duck. For the 10-day-old bobwhite quail (MRID 475601-20) and the 10-day-old mallard duck (MRID 475601-19), both studies showed a complete lack of mortality and sublethal effects. There were no signs of toxicity, effects on body weight, or changes in food consumption between the control and treatment groups. For both studies, the 8-day LC_{50} was >5290 mg a.e./kg-diet, and the NOAEC was 5290 mg a.e./kg-diet. These results classify the acid as practically non-toxic to juvenile bobwhite quails and mallard ducks.

The four avian acute toxicity studies are summarized in **Table 4.9**.

Table 4.9. Toxic Effects in Birds Due to Acute Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value (Endpoints)	Toxicity Classification	Study Classification	MRID #
850.2100 Oral Toxicity acid	Bobwhite Quail (*Colinus virginianus*)	LD_{50}: >2075 mg a.e./kg-bw NOAEL: 2075 mg a.e./kg-bw (no effects)	Practically Non-toxic	Acceptable	475601-18
850.2100 Oral Toxicity ester	Bobwhite Quail (*Colinus virginianus*)	LD_{50}: >2045 mg a.e./kg-bw NOAEL: 442 mg a.e./kg-bw (male body weight)	Practically Non-toxic	Acceptable	475602-05
850.2200 Dietary Toxicity acid	Bobwhite Quail (*Colinus virginianus*)	LC_{50}: >5290 mg a.e./kg-diet NOAEC: 5290 mg a.e./kg-diet (no effects)	Practically Non-toxic	Acceptable	475601-20
850.2200 Dietary Toxicity acid	Mallard Duck (*Anas platyrhynchos*)	LC_{50}: >5290 mg a.e./kg-diet NOAEC: 5290 mg a.e./kg-diet (no effects)	Practically Non-toxic	Acceptable	475601-19

Chronic dietary reproduction toxicity studies with the acid were submitted for each of the bobwhite quail (MRID 475601-21) and mallard duck (MRID 475601-22). In the quail study, cages were approximately six times smaller than recommended in the guideline. Seven incidental mortalities occurred in the control and all three treatment groups. It is possible that the small cage size contributed to these mortalities as external injuries, including bruising, fractures, and necrotic lesions, were observed. Therefore, the improper husbandry practices used in the study may have affected reproductive endpoints in both the control and treatment groups. The study is classified as invalid and does not satisfy guideline requirements. In the mallard study, cages were approximately three times smaller than recommended in the guideline. Three incidental mortalities were observed in the control and the two lower treatment groups. It is possible that cage size may have affected the reproductive endpoints measured in this study in all treatment levels, including the controls. Additionally, sixteen hens in the control and treatment groups were observed to be non-productive (less than ten eggs laid). Necropsy showed that egg yolk peritonitis was apparent in the non-laying hens. Although this endpoint may not be treatment-related, the health of the birds is questionable. This study is classified as invalid and does not satisfy guideline requirements.

4.2.2 Toxicity Effects on Mammals

An acute oral acid toxicity study on the rat was conducted using the up-and-down procedure (MRID 475599-34). Three female rats were dosed with 5000 mg a.e./kg-bw (acid, 92.2% purity) and observed for fourteen days. The day after dosing, one rat had diarrhea but recovered by the next day. There were no mortalities or clinical signs of toxicity at the end of the test; necropsies did not show any gross lesions. The LD_{50} was determined to be >5000 mg a.e./kg-bw, and the study was classified as acceptable.

An acute oral ester toxicity study on the rat was conducting using the up-and-down procedure (MRID 475600-27). Six female rats were dosed with 175, 550, 1750, or 5000 mg a.e./kg-bw (ester, 96.9% purity) by gavage (three rats were dosed at the 5000 mg/kg-bw treatment level) and observed for fourteen days. One rat at the 5000 mg a.e./kg-bw treatment level exhibited lethargy on the day of dosing and hair loss (forelimbs) on days 13 and 14. However, all animals survived and gained weight during the study. The other animals had no clinical signs during the study. No treatment related gross lesions were noted at necropsy. The LD_{50} was determined to be >5000 mg a.e./kg-bw, and the study was classified as acceptable.

In a two-generation reproduction toxicity study (MRID 475751-01), 28 rats/sex/dose group were exposed to the acid (90.9-92.2% purity) at dietary levels of 0, 500, 1500, 5000, or 17,000 ppm (equivalent to 0/0, 36/41, 109/125, 363/416, and 1285/1454 mg a.e./kg-bw/day in males/females during pre-mating) for two successive generations with one litter per generation. No treatment-related effects were observed on mortality, clinical signs, or macroscopic or microscopic findings. The LOAEC for parental toxicity was 17,000 ppm (equivalent to 1285/1454 mg/kg in males/females), based on decreased body weights in parental males and females. The NOAEC was 5000 ppm (equivalent to 363/416 mg/kg in males/females). The LOAEC for offspring toxicity was 17,000 ppm (equivalent to 1285/1454 mg/kg in males/females), based on decreased body weights in the F1 and F2 pups. The NOAEC was 5000 ppm (equivalent to 363/416 mg/kg in males/females). The LOAEC for reproductive toxicity was not observed. The NOAEC was 17,000 ppm (equivalent to 1285/1454 mg/kg in males/females). This study was classified as acceptable.

Results of the three mammalian toxicity studies are summarized in **Table 4.10.**

Table 4.10. Toxic Effects in Mammals Due to Exposure to Aminocyclopyrachlor

Study Type	Species	Toxicity Value (Endpoints)	Toxicity Classification	Study Classification	MRID #
870.1100 Oral Toxicity acid (92.2%)	Laboratory Rat (*Rattus norvegicus*)	LD_{50}: >5000 mg a.e./kg-bw	Category IV (Practically Non-toxic)	Acceptable	475599-34
870.1100 Oral Toxicity ester (96.9%)	Laboratory Rat (*Rattus norvegicus*)	LD_{50}: >5000 mg a.e./kg-bw	Category IV (Practically Non-toxic)	Acceptable	475600-27
870.3800 2-Generation Reproduction	Laboratory Rat (*Rattus norvegicus*)	NOAEL: 363 mg a.e./kg-bw LOAEL: 1285 mg a.e./kg-bw (decreased parental male and	NA	Acceptable	475751-01

Toxicity acid (90.9-92.2%)		F1 and F2 male pup body weights)			
Formal reviews of mammalian data were conducted by the Health Effects Division.					

4.2.3 Toxicity Effects on Invertebrates

An acute earthworm toxicity test with the ester (MRID 475602-08) was submitted and classified as supplemental because an OPPTS acute toxicity guideline does not exist for earthworms. Earthworms were exposed to the ester at concentrations between 123 and 909 mg a.e./kg-dw soil for 14 days. No mortalities or behavioral abnormalities were observed in the control or treatment groups throughout the definitive exposure period. By test termination, mean weight loss was 4.33% in the solvent control and 5.41, 5.36, 10.68, 12.98, and 12.18% in the 123, 203, 334, 551, and 909 mg a.e./kg-dw soil treatment groups, respectively. The EC_{50} was >909 mg a.e./kg-dw soil. The NOAEC and LOAEC values, based on % body weight loss, were 203 and 334 mg a.e./kg-dw soil, respectively.

A study was submitted that evaluated the acute contact toxicity and acute oral toxicity of the acid on female young adult worker honey bees (MRID 475601-31). In the contact portion of the study, there was a complete lack of mortality and sublethal effects at any treatment level after 48 hours. The LD_{50} was >100 µg a.e./bee, and the NOAEL was 100 µg a.e./bee. The contact portion of the study satisfies guideline requirements and classifies the acid as practically non-toxic. In the oral portion of the study, there were no significant mortalities. Sublethal effects were observed at 24 hours and included one apathetic bee at the 28.09 µg a.e./bee treatment level and eight bees with coordination problems at the 112.03 µg a.e./bee treatment level. However, these effects were not observed at 48 hours. The resulting LC_{50} was >112.03 µg a.e./bee, and the NOAEL was 112.03 µg a.e./bee. The Agency does not have a data requirement or an acute oral toxicity guideline for the honey bee. Therefore, the data is considered supplemental but classified as acceptable since it was submitted in the same study as the acute contact toxicity test. The results from both the acute and contact toxicity tests are summarized in **Table 4.11**. Based on the toxicity values obtained from the acute contact and acute oral honey bee studies, no additional honey bee studies (foliage residue or field) are needed at this time.

Table 4.11. Toxic Effects in Earthworms (*Eisenia fetida*) and Honey Bee (*Apis mellifera*) Due to Acute Exposure to Aminocyclopyrachlor

Study Type	Toxicity Value	Toxicity Classification	Study Classification	MRID #
OECD TG 207 Acute Toxicity Ester (90.9% a.e.)	LC_{50}: >909 mg a.e./kg-dw soil EC_{50}: >909 mg a.e./kg-dw soil NOAEC: 203 mg a.e./kg-dw soil (% body weight)	N/A	Supplemental	475602-08
850.3020 Contact Toxicity acid (92.2%)	LD_{50}: >100 µg a.e./bee NOAEL: 100 µg a.e./bee (no effects)	Practically Non-toxic	Acceptable	475601-31

OECD TG 213 Oral Toxicity acid (92.2%)	LD_{50}: >112.03 µg a.e./bee NOAEL: 112.03 µg a.e./bee (sublethal effects were observed at 24 hours but were no longer apparent at 48 hours)	N/A	Acceptable*	457601-31
*The Agency does not have a data requirement or a guideline for an acute oral toxicity test. This study would normally be classified as supplemental; however, it was submitted in the same study as the acute contact toxicity test, which was classified as acceptable.				

4.2.4 Toxicity Effects on Plants

Two Tier II studies were submitted that evaluated the use of an ester formulation, DPX-KJM44 80WG, on the seedling emergence (MRID 475601-32) and the vegetative vigor (MRID 475601-33) of terrestrial plants. In the seedling emergence study, four monocots (corn, onion, oat, and ryegrass) and six dicots (bean, cucumber, oilseed rape, soybean, sugarbeet, and tomato) were tested at nine concentrations between 0.000054 and 0.355 lb a.e./acre. Species were affected at every endpoint evaluated, which included emergence, survival, shoot height, and dry weight. Effects tended to demonstrate a dose-response relationship. Mortality, necrosis, chlorosis, stem curl, unshed seed coat, and leaf curl were effects observed in all species tested. The most sensitive monocot species, based on shoot height, was onion with NOAEC and EC_{25} values of 0.0394 and 0.048 lb a.e./acre, respectively. The most sensitive dicot species, based on shoot height, in the seedling emergence test was sugarbeet with NOAEC and EC_{25} values of 0.00049 and 0.00053 lb a.e./acre, respectively.

In the vegetative vigor study, the same ten species were tested as in the seedling emergence study and concentrations were between 0.0000076 and 0.355 lb a.e./acre, depending on the species. Every species except ryegrass was affected for the dry weight and shoot height endpoints, while survival was the least sensitive endpoint evaluated. Effects tended to demonstrate a dose-response relationship. Chlorosis, leaf curl, mortality, necrosis, and stem curl were effects observed at the higher treatment levels for most species tested. Ryegrass only had two affected replicates at the highest treatment level. Bean, sugarbeet, tomato, and soybean were affected at almost every test level. Onion was the most sensitive monocot, based on dry weight, with NOAEC and EC_{25} values of 0.0028 and 0.0058 lb a.e./acre, respectively. Bean was the most sensitive dicot, based on shoot height, with EC_{05} (NOAEC was non-definitive) and EC_{25} values of 0.00000078 and 0.000075 lb a.e./acre, respectively. However, the estimated EC_{05} is outside the range of treatment concentrations; therefore, there is very little confidence in this value. The results of these two studies are summarized in **Table 4.12**.

Table 4.12. Non-target Terrestrial Plant Seedling Emergence and Vegetative Vigor Toxicity (Tier II) Data for Aminocyclopyrachlor, DPX-KJM44 80WG (76.5% a.e.)

Crop	Species	NOAEC (lb a.e./acre)	EC_{25} (lb a.e./acre)	Most Sensitive Endpoint
Seedling Emergence (850.4225) MRID 475601-32 (Acceptable)				
Monocot	Corn	0.0394	0.15	Shoot height
	Oat	0.355	>0.355	None

Table 4.12. Non-target Terrestrial Plant Seedling Emergence and Vegetative Vigor Toxicity (Tier II) Data for Aminocyclopyrachlor, DPX-KJM44 80WG (76.5% a.e.)				
Crop	**Species**	**NOAEC (lb a.e./acre)**	**EC_{25} (lb a.e./acre)**	**Most Sensitive Endpoint**
	Onion*	0.0394	0.048	Shoot height
	Ryegrass	0.0394	0.075	Dry weight
Dicot	Bean	0.00147	0.0053	Dry weight
	Cucumber	0.0131	0.032	Dry weight
	Oilseed Rape	0.00439	0.0025	Dry weight
	Soybean	0.000012[1]	0.00077	Dry weight
	Sugarbeet*	0.00049	0.00053	Shoot height
	Tomato	0.00439	0.0047	Dry weight
Vegetative Vigor (850.4250) MRID 475601-33 (Acceptable)				
Monocot	Corn	0.012	0.096	Shoot Height
	Oat	0.033[1]	0.16	Dry Weight
	Onion*	0.0028	0.0058	Dry Weight
	Ryegrass	0.355	>0.355	None
Dicot	Bean*	0.00000078[1]	0.000075	Shoot Height
	Cucumber	0.00035	0.00098	Dry Weight
	Oilseed Rape	0.00035	0.0004	Shoot Height
	Soybean	0.000068	0.00064	Dry Weight
	Sugarbeet	0.00018	0.00056	Dry Weight
	Tomato	0.00018	0.00073	Dry Weight

[1]In cases where there was not a definitive NOAEC, the EC_{05} is presented. However, there is very little confidence in these values as they were outside the range of treatment concentrations.
*Species with the lowest EC_{25}; used for risk quantification

4.3 Comparison of Ester and Acid Toxicity

Three studies were submitted that evaluated the acute effects of the ester on a freshwater fish, freshwater invertebrate, and upland game bird. Although rapid hydrolysis of the ester to the acid under environmental conditions is expected to occur, the submitted toxicity studies do not confirm equivalent toxicity. The submitted rainbow trout ester study (MRID 475602-06) was about an order of magnitude (or more due to the acid's non-definitive LC_{50}) more toxic than the acid (MRID 475601-23). The daphnid ester study (MRID 475602-07) was about twice as toxic as the acid (MRID 475601-26). While both the ester and the acid bobwhite quail studies showed aminocyclopyrachlor to be practically non-toxic based on mortality, a sublethal effect was observed in the ester study; male body weight was affected by exposure to the ester (MRID 475602-05) at a level about five times lower than the level that produced no effects by the acid (MRID 475601-18). Both the acute oral mammalian studies for the acid and ester did not show any toxicity or sublethal effects (MRID 475599-34, 475600-27).

4.4 Review of Incident Data

As of October 30, 2009, aminocyclopyrachlor had not yet been included in the EIIS database for ecological incidents. However, the lack of reported incidents does not preclude potential risks to terrestrial and aquatic non-target organisms.

An investigation of the EIIS database shows that concerns have been raised with a similar class of herbicides, the pyridine carboxylic acids. Several incidents have been reported involving residues of clopyralid, picloram, and aminopyralid in compost causing crop injury; some of these incidents have caused regulatory actions to be taken. Incidents involving aminopyralid in the United Kingdom resulted in a temporary suspension of sales of products containing aminopyralid. Incidents involving clopyralid resulted in the state of Washington banning it from use on lawns and turf; the registrant subsequently voluntarily cancelled clopyralid's use on lawns in Washington. Similarly, the California Department of Pesticide regulation cancelled clopyralid's uses on residential lawns. Residues detected in lawn clippings and compost have prompted other states to be on alert for potential issues involving these types of herbicides.

Although aminocyclopyrachlor belongs to the pyrimidine carboxylic acids family, it is persistent, systemic, and has high seedling emergence toxicity. Therefore, aminocyclopyrachlor residues may end up in treated plant materials used in compost or for feed for animals whose manure is used in compost, which has the potential to cause similar incidents as those reported for aminopyralid, picloram, and clopyralid.

4.5 Review of ECOTOX Data

A search of the public ECOTOX database (http://cfpub.epa.gov/ecotox) was conducted on October 30, 2009. No studies were found that evaluated the effects of aminocyclopyrachlor on non-target organisms.

5 Risk Characterization

Risk characterization is the integration of exposure and effects characterization to determine the potential for ecological risks to non-target organisms including aquatic life, wildlife, and plants from the use of aminocyclopyrachlor according to the proposed labels. The risk characterization provides an estimation and description of the risk; articulates risk assessment assumptions, limitations, and uncertainties; synthesizes an overall conclusion; and provides the risk managers with information to make regulatory decisions.

5.1 Risk Estimation: Integration of Exposure and Effects Data

Results of the exposure and toxicity effects data are used to evaluate the potential for adverse ecological effects on non-target species. For the assessment of potential risks of aminocyclopyrachlor, the risk quotient (RQ) method is used to compare exposure and measured acute or chronic toxicity values:

$$RQ = EEC / Toxicity\ Value$$

where: *EEC* is the estimated environmental concentration generated by the exposure scenarios. The RQs are compared to the Agency's levels of concern (LOCs). These LOCs are the Agency's interpretive policy and are used to analyze potential risk to non-target organisms and the need to consider regulatory action (see **Appendix D**). These criteria are used to indicate when a pesticide's use as directed on the label has the potential to cause adverse effects on non-target organisms.

5.1.1 Non-target Aquatic Fish, Invertebrates, and Plants

The highest surface water concentrations resulting from aminocyclopyrachlor application were predicted using a non-crop scenario. Because the turf single application rates were lower than the maximum single application rate for non-crop areas, turf scenarios produced lower surface water concentration estimates. Application scenarios were selected to represent the entire range of soil and environmental conditions of the proposed actions. EECs are based on aminocyclopyrachlor parent. This conservative approach will approximate maximum exposure.

Peak EECs were compared to acute toxicity endpoints to derive acute risk quotients. The 21-day EECs were compared to chronic toxicity endpoints (NOAEC values) to derive chronic risk quotients for invertebrates. The 60-day EECs were compared to chronic toxicity endpoints (NOAEC values) to derive chronic risk quotients for fish.

Fish

For the acid, no toxicity was observed at the highest concentration tested (120-129 mg a.e./L) for freshwater and estuarine/marine fish. Therefore, acute risk quotients were not calculated and RQs would not be expected to exceed LOCs.

For the ester, an LC_{50} was observed to be 13 mg a.e./L for bluegill sunfish. The resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86 ppb/13,000 ppb = 0.0013) does not exceed any of the acute LOCs for the highest proposed application rate.

The NOAEC produced by the chronic rainbow trout study was 11 mg a.e./L (acid). The resulting RQ of <0.01 (60-day EEC/Toxicity Value = 16.64 ppb/11,000 ppb = 0.0015) does not exceed the chronic LOC for the highest proposed application rate. A chronic estuarine/marine fish study was not submitted. The acute-to-chronic ratio cannot be used to predict potential chronic risks to estuarine/marine fish because the most sensitive acute freshwater fish uses the ester whereas the submitted chronic freshwater and acute estuarine/marine fish studies use the acid. In addition, the acute estuarine/marine fish study produced a non-definitive LC_{50}.

Freshwater Invertebrates

For the acid, an LC_{50} of 39.7 mg a.e./L was observed. The resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86 ppb/39,700 ppb = 0.00042) does not exceed any of the acute LOCs for the highest proposed application rate.

Similarly, for the ester, an LC_{50} of 19.8 mg a.e./L was observed. The resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86 ppb/19,800 ppb = 0.00085) does not exceed any of the acute LOCs for the highest proposed application rate.

A definitive NOAEC was not produced by the chronic daphnid study (acid). The study was considered supplemental and the data did not allow for quantification of potential chronic risks. Chronic risks are assumed for non-listed and listed species due to lack of acceptable data.

Estuarine/Marine Invertebrates

Mortality was not observed in the Eastern oyster shell deposition toxicity test; however, a NOAEC of 67 mg a.e./L was observed. The resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86 ppb/67,000 ppb = 0.00025) does not exceed the LOCs. No mortality or effects were observed in the mysid shrimp acute toxicity test. Therefore, acute RQs were not calculated and RQs would not be expected to exceed LOCs.

A chronic estuarine/marine invertebrate study was not submitted. Because the chronic freshwater invertebrate study did not produce a definitive NOAEC, the acute-to-chronic ratio cannot be used to estimate potential chronic risks to estuarine/marine invertebrates. Chronic risks are assumed for non-listed and listed species due to lack of acceptable data.

Aquatic Plants

Of the four non-vascular plant and one vascular plant studies submitted, blue-green algae produced the lowest EC_{50} at 7.4 mg a.e./L. The resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86 ppb/7,400 ppb = 0.0023) did not exceed the acute LOC for non-listed species. Similarly, using the NOAEC of 1.1 mg a.e./L for blue-green algae, the resulting RQ of <0.01 (Peak EEC/Toxicity Value = 16.86/1,100 ppb = 0.015) did not exceed the acute LOC for listed species.

5.1.2 Non-target Terrestrial Animals

Birds

For the acid, no mortality or effects were observed in the bobwhite quail acute oral toxicity test and the bobwhite quail and mallard duck acute dietary toxicity tests. Therefore, acute risk quotients were not calculated and RQs would not be expected to exceed LOCs.

For the ester, no mortality was observed. However, male body weight was affected at a treatment level that was almost five times lower (442 mg a.e./kg-bw) than the level that produced no sublethal affects with the acid (2075 mg a.e./kg-bw). The T-REX model does not currently quantify potential risks due to acute sublethal effects; refer to **Section 5.2.2** for a description of potential risk due to reduced male body weight.

The submitted avian reproduction studies were classified as invalid (see **Section 4.2.1** for details). Chronic reproductive risks to birds are assumed for non-listed and listed species due to lack of acceptable data.

Mammals

The acute oral rat studies submitted for both the acid and the ester did not show any mortality or signs of sublethal effects. Therefore, acute risk quotients were not calculated and RQs would not be expected to exceed LOCs.

The chronic two-generation rat reproduction study produced a NOAEC of 5000 ppm and a corresponding estimated daily dose of 363 mg a.e./kg-bw. There were no exceedances of the chronic LOC at the highest single maximum application rate (0.284 lb a.e./acre). Chronic mammalian RQs are summarized in **Table 5.1**.

Table 5.1. Summary of Mammalian Chronic Risk Quotients for a Proposed Aminocyclopyrachlor Application

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs			Chronic Dietary-Based RQs
	15 g	35 g	1000 g	
	Chronic	Chronic	Chronic	
(352-TII) Herbicide on Non-crop Areas 1 application at 0.284 lb a.e./acre				
Short grass	0.08	0.07	0.04	0.01
Tall grass	0.04	0.03	0.02	0.01
Broadleaf plants/small insects	0.05	0.04	0.02	0.01
Fruits/pods/seeds/lg insects	0.01	<0.01	<0.01	<0.01
Granivores	<0.01	<0.01	<0.01	-

Terrestrial Invertebrates

EFED does not currently quantify risks to non-listed terrestrial non-target insects. Risk quotients are not calculated for these organisms. The honey bee is used as a surrogate for all terrestrial invertebrates. Aminocyclopyrachlor is classified as practically non-toxic based on the acute contact honey bee study (LD_{50} >100 µg a.i./bee). Similarly, the acute oral study resulted in a non-definitive LD_{50} as well (>112.03 µg a.i./bee).

5.1.3 Terrestrial and Semi-aquatic Plants

Terrestrial and semi-aquatic plants may be exposed to pesticides from runoff and spray drift. Semi-aquatic plants are those that inhabit low-lying wet areas that may be dry at certain times of the year. EECs for terrestrial and semi-aquatic plants are derived for areas adjacent to the treatment site. Acute RQs for terrestrial plants are derived by dividing the EEC by the EC_{25} from Tier II seedling emergence and vegetative vigor toxicity tests. Acute RQs for listed plant species are calculated by dividing the EEC by the NOAEC (if not available, an EC_{05} is used) value from Tier II toxicity tests.

Terrestrial plant EECs and toxicity endpoints are provided in **Tables 3.10** and **4.11,** respectively. EECs and RQs for applications to non-crop areas and turf are calculated using TerrPlant v1.2.2 (**Appendix C**) and RQs are summarized in **Table 5.2**.

As expected because aminocyclopyrachlor is an herbicide, several RQs exceeded the LOC. RQs ranged from <0.1 (no spray drift due to granular application) to 18,205.13. The spray drift RQs for listed dicots are based on an EC_{05} because the NOAEC produced was non-definitive. This EC_{05} was outside the range of concentrations tested; therefore, there is very little confidence in this estimated toxicity value.

Table 5.2. Risk quotient (RQ) values for plants in dry and semi-aquatic areas exposed to aminocyclopyrachlor through runoff and/or spray drift					
		Listed Status	**Dry**	**Semi-Aquatic**	**Spray Drift**
Turf – ground application (granule) 0.108 lb a.e./acre	Monocot	Non-listed	0.11	**1.13***	<0.1
	Monocot	Listed	0.14	**1.37***	<0.1
	Dicot	Non-listed	**10.19***	**101.89***	<0.1
	Dicot	Listed	**11.02***	**110.20***	<0.1
Turf – ground application (spray) 0.094 lb a.e./acre	Monocot	Non-listed	0.12	**1.00***	0.16
	Monocot	Listed	0.14	**1.22***	0.34
	Dicot	Non-listed	**10.64***	**90.45***	**12.53***
	Dicot	Listed	**11.51***	**97.84***	**1205.13*+**
Non-crop Areas – ground application (spray) 0.284 lb a.e./acre	Monocot	Non-listed	0.36	**3.02***	0.49
	Monocot	Listed	0.43	**3.68***	**1.01***
	Dicot	Non-listed	**32.15***	**273.28***	**37.87***
	Dicot	Listed	**34.78***	**295.59***	**3641.03*+**
Non-crop Areas – aerial application (spray) 0.284 lb a.e./acre	Monocot	Non-listed	0.59	**3.25***	**2.45***
	Monocot	Listed	0.72	**3.96***	**5.07***
	Dicot	Non-listed	**53.58***	**294.72***	**189.33***
	Dicot	Listed	**57.96***	**318.78***	**18205.13*+**

*Exceeds LOC of 1.0
+The listed dicot vegetative vigor EC_{05} (0.00000078 lb a.e./acre) was used in the absence of a definitive NOAEC. However, there is very little confidence in this estimated value as it is outside the range of test concentrations.

5.2 Risk Description

A screening-level (Level I) risk assessment, based on the proposed uses of aminocyclopyrachlor on non-crop areas and turf, suggests that levels of aminocyclopyrachlor in the environment, when compared with the most sensitive toxicity values for a given taxa, may result in direct adverse effects to terrestrial plants. These direct effects may also result in indirect risk to non-target species through reduction of habitat or food sources. Due to lack of acceptable data for some taxa and lack of data for the degradates, not all potential risks are known. Structure activity relationships (SARs), total toxic residue (TTR), and comparisons of environmentally relevant concentrations relative to effects thresholds are methods used to reduce uncertainties due to degradate toxicities (see **Section 5.2.3**).

5.2.1 Risks of Aminocyclopyrachlor to Aquatic Organisms

Acute and chronic risk quotients for all aquatic taxa were predicted to be below LOCs when data were available. However, in the absence of data, chronic risks are assumed for non-listed and listed species; these taxa include freshwater and estuarine/marine invertebrates. Submission of chronic toxicity data for freshwater invertebrates has a high potential to add value to this ecological risk assessment by reducing uncertainties, which cannot be done using alternate methods or weights of evidence.

Although it was determined that the ester does not have equivalent toxicity to the acid (see **Sections 2.2.3** and **2.6.2**), the RQs that were calculated for the ester did not exceed any of the LOCs. Submission of acute estuarine/marine and aquatic plant toxicity data for the ester has a low potential to add value to this ecological risk assessment because this additional data would have to show about a three to four orders of magnitude increase in toxicity over the available acid data to cause LOC exceedances.

5.2.2 Risks of Aminocyclopyrachlor to Terrestrial Organisms

Birds and Mammals

Acute risk quotients for birds (and terrestrial amphibians/reptiles) would fall below LOCs due to lack of toxicity observed in submitted studies. However, in the avian acute oral study with the ester, reduction in male body weight was observed. This is a significant adverse sublethal effect that may result in changes in survival, growth, reproduction of wild birds. Chronic risks for birds cannot be precluded for non-listed and listed species due to lack of acceptable avian reproduction data. Submission of chronic toxicity data for birds has a high potential to add value to this ecological risk assessment by reducing uncertainties, which cannot be done using alternate methods or weights of evidence. Acute and chronic risk quotients for mammals fell below LOCs. From submitted studies, it was determined that the ester would have equivalent acute and chronic toxicity to birds and mammals as the acid. The currently proposed salt uses would not result in release of the salt to the environment; however, if different formulations for the salt are proposed in the future that would result in release of the salt to the environment, there may be potential for risks to birds and mammals. In this case, salt toxicity data may be needed to adequately assess potential risks.

Terrestrial Plants

Aminocyclopyrachlor is proposed for pre- and post-emergent control of broadleaf weeds and grasses. As such, it is expected that aminocyclopyrachlor would present potential risks to terrestrial and semi-aquatic plants. RQs exceeded LOCs for the highest use rates, including a granular form. The submitted labels include statements to reduce the potential for spray drift. If future uses are proposed for crop uses, it may be necessary to require a vegetative buffer strip to reduce risks to non-target plants.

Although the current proposed uses are for non-crop areas and turf, a spray drift buffer analysis was conducted to estimate the buffer distances required to reduce the potential for effects to non-target terrestrial plants. AgDRIFT was used to model the dissipation distance to the EC_{25} levels for non-listed terrestrial plants and to NOAEC levels for listed terrestrial plants. A drop size distribution of ASAE Very Fine to Fine was chosen to reflect the proposed label language (352-TII was used as an example). Buffer distances were calculated for the most sensitive endpoints for both monocots and dicots in the seedling emergence and vegetative vigor studies. For ground applications, only a Tier I assessment exists. In the event that a Tier II aerial application resulted in an out-of-range estimation (>1000 feet), the Tier III AgDRIFT model could be used to estimate distances up to 2640 feet.

Non-listed Species
Dissipation distances ranged from 16.4 to >1000 feet for Tier I ground applications at the maximum proposed application rate (0.284 lb a.e./acre). At the lower rate (0.094 lb a.e./acre), dissipation distances ranged from 6.56 to >1000 feet for Tier I ground applications. For aerial applications (TII or TIII), dissipation distances ranged from 108.27 to >2640 feet at the higher rate (0.284 lb a.e./acre). The lower application rate is proposed for ground application only. Dissipation distances can be found in **Table 5.3** for non-listed species.

Listed Species
Dissipation distances ranged from 19.68 to >1000 feet for Tier I ground applications at the maximum proposed application rate (0.284 lb a.e./acre). At the lower rate (0.094 lb a.e./acre), dissipation distances ranged from 6.56 to >1000 feet for Tier I ground applications. For aerial applications (TII or TIII), dissipation distances ranged from 131.23 to >2640 feet at the higher rate (0.284 lb a.e./acre). The lower application rate is proposed for ground application only. Dissipation distances can be found in **Table 5.4** for listed species.

AgDRIFT does not address chronic concerns and only functions to model single applications. Because the proposed application rates for aminocyclopyrachlor vary based on the application site and end-user, the highest spray application rate was chosen (0.284 lb a.e./acre for non-crop areas) and the lowest spray application rate was chosen (0.094 lb a.e./acre for professional turf uses). Other higher turf application rates have been proposed, but these are granular formulations. It is important to note that AgDRIFT assumes an entire acre has been treated, which may not necessarily be true in the case of non-crop area and turf uses.

5.3 Estimation of Buffer Distance Required to Eliminate LOC Exceedances (only spray drift exposure considered) for Non-listed Terrestrial Plants Based on AgDRIFT

	EC_{25} (lb a.e./acre)	Fraction of applied $= EC_{25} \div$ Rate	Buffer Width, aerial (ft) [1]	Buffer Width, ground (ft) [2]
Application Rate = 0.284 lb a.e./acre (aerial/ground application)				
Seedling Emergence Monocots	0.048	0.169	108.27 (TII)	16.4
Seedling Emergence Dicots	0.00053	0.00187	>2640 (TIII)	833.32
Vegetative Vigor Monocots	0.0058	0.0204	1748.67 (TIII)	121.39
Vegetative Vigor Dicots	0.000075	0.000264	>2640 (TIII)	>1000
Application Rate = 0.094 lb a.e./acre (ground application)				
Seedling Emergence Monocots	0.048	0.511	NA	6.56
Seedling Emergence Dicots	0.00053	0.00564	NA	380.57
Vegetative Vigor Monocots	0.0058	0.0617	NA	42.65
Vegetative Vigor Dicots	0.000075	0.000798	NA	>1000

[1] Aerial application scenarios are modeled with AgDrift Tier I (TI) and AgDrift Tier III (TIII)
[2] Ground application scenarios are modeled with AgDrift Tier I, no higher tiers available

5.4 Estimation of Buffer Distance Required to Eliminate LOC Exceedances (only spray drift exposure considered) for Listed Terrestrial Plants Based on AgDRIFT				
	NOAEC (lb a.e./acre)	Fraction of applied = NOAEC ÷ Rate	Buffer Width, aerial (ft) [1]	Buffer Width, ground (ft) [2]
Application Rate = 0.284 lb a.e./acre (aerial/ground application)				
Seedling Emergence Monocots	0.0394	0.1387	131.23 (TII)	19.68
Seedling Emergence Dicots	0.00049	0.00172	>2640 (TIII)	879.25
Vegetative Vigor Monocots	0.0028	0.0098	>2640 (TIII)	242.78
Vegetative Vigor Dicots	0.00000078[3]	0.00000275	>2640 (TIII)	>1000
Application Rate = 0.094 lb a.e./acre (ground application)				
Seedling Emergence Monocots	0.0394	0.4191	NA	6.56
Seedling Emergence Dicots	0.00049	0.00521	NA	403.54
Vegetative Vigor Monocots	0.0028	0.0298	NA	85.3
Vegetative Vigor Dicots	0.00000078[3]	0.00000830	NA	>1000

[1]Aerial application scenarios are modeled with AgDrift Tier I (TI) and AgDrift Tier III (TIII)
[2]Ground application scenarios are modeled with AgDrift Tier I, no higher tiers available
[3]EC_{05} used in the absence of a definitive NOAEC

Ground water used for irrigation purposes is another potential route of exposure for terrestrial plants due to aminocyclopyrachlor's ability to leach to and accumulate in ground water. However, because the proposed uses are restricted to non-crop and turf areas, EFED did not estimate ground water EECs using SCI-GROW. If uses are proposed for crop areas in the future, this would be a valuable risk characterization tool.

5.2.3 Potential Risks Due to Exposure to the Degradates

No toxicity data on degradates have been submitted. Therefore, estimated toxicity values were generated using structure activity relationships (SARs) based on the ECOSAR program (version 1.00) for the purpose of identifying degradates that may need additional investigation. ECOSAR is a publically available[1] computerized predictive system that estimates the aquatic toxicity of chemicals. The program estimates a chemical's acute (short-term) toxicity and chronic (long-term or delayed) toxicity to aquatic organisms such as fish, aquatic invertebrates, and aquatic plants by using SARs.

The results of this modeling exercise suggest that two degradates, IN-LXT69 and IN-YY905, may be more toxic than the parent to daphnids on a chronic basis (**Table 5.5**, see **Appendix E** for ECOSAR outputs).

[1] http://www.epa.gov/oppt/newchems/tools/21ecosar.htm

Currently, there is no reliable SAR available that estimates the toxicity of pesticides to birds. Therefore, the evaluation of degradates conducted by the Health Effects Division (HED) is generally used to evaluate the potential toxicity of degradates to mammals and birds. Based on the analysis, IN-V0977 may be more toxic to birds and mammals than the parent chemical. It forms via aqueous photolysis in quantities up to 14.6% of parent. Potential routes of exposure to birds and mammals for this degradate is through drinking water (dew and puddles) and dermal exposure. However, by comparing the concentrations expected in the environment to the effects thresholds, IN-V0977 would have to be more than two orders of magnitude more toxic than the parent compound to cause LOC exceedances.

Table 5.5. Major Degradates of Aminocyclopyrachlor Acid

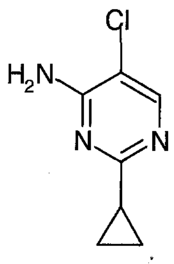
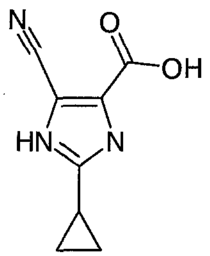
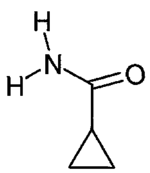
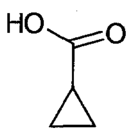
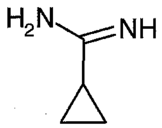
Name of Degradate and Structure	Maximum Detected (%)	Formation Pathway	Estimated Toxicity
IN-LXT69 	16.1	Aqueous Photolysis MRID 475602-11	Fish LC50: 80 mg/L Daphnid EC50: 3 mg/L Algae Ec50: 10 mg/L Fish ChV: 0.4 mg/L Daphnid ChV: 0.05 mg/L Algae ChV: 6.5 mg/L
IN-QFH57 	33.1	Aqueous Photolysis MRID 475602-11	Fish LC50: 1000 mg/L Daphnid EC50: 10 mg/L Algae Ec50: No SAR Fish ChV: 100 mg/L Daphnid ChV: 0.9 mg/L Algae ChV: No SAR
IN-Q3007 	24.4	Aqueous Photolysis MRID 475602-11	Fish LC50: 800 mg/L Daphnid EC50: 200 mg/L Algae Ec50: 0.8 mg/L Fish ChV: 5 mg/L Daphnid ChV: 2.7 mg/L Algae ChV: 0.1 mg/L
IN-V0977 	14.6	Aqueous Photolysis MRID 475602-11	Fish LC50: >100 mg/L Daphnid EC50: >100 mg/L Algae Ec50: >100 mg/L Fish ChV: >100 mg/L Daphnid ChV: >100 mg/L Algae ChV: >100 mg/L

Table 5.5. Major Degradates of Aminocyclopyrachlor Acid			
Name of Degradate and Structure	**Maximum Detected (%)**	**Formation Pathway**	**Estimated Toxicity**
IN-YY905 	11.7	Aqueous Photolysis MRID 475602-11	Fish LC50: >100 mg/L Daphnid EC50: >100 mg/L Algae Ec50: 15 mg/L Fish ChV: 30 mg/L Daphnid ChV: 0.02 mg/L Algae ChV: 16 mg/L
CO_2 O=C=O	23.1	Aerobic Soil Met. MRID 475602-14	--
(unidentified)	16.8	Aqueous Photolysis MRID 475602-11	--

The total toxic residue (TTR) approach is used by EFED to evaluate potential risks to non-target organisms from aquatic exposure to degradates. TTRs represent potential combined exposures to the parent chemical and its degradates. However, due to the stability of the parent aminocyclopyrachlor, TTR values are expected to be similar to the EECs presented in this assessment for the parent chemical alone.

Degradation half-lives used in GENEEC to estimate EECs for the parent chemical were long and essentially stable. Aqueous photolysis is the only degradation pathway input into GENEEC for which aminocyclopyrachlor degrades more rapidly (half-life = 7.8 days). However, GENEEC-estimated EECs are not sensitive to aqueous photolysis inputs.

To investigate how aqueous photolysis affected EECs, GENEEC was run with short ($t_{1/2}$ = 1.0 day) and long ($t_{1/2}$ = 0 day = stable) half-lives using the proposed maximum application rates for non-crop areas and turf. All other inputs were kept constant and were not changed from the inputs previously presented in **Table 3.6**. The results for non-crop uses show the peak EEC for photolysis set at $t_{1/2}$ = 0 days (stable) was 16.86 ppb and the peak EEC for photolysis set at $t_{1/2}$ = 1 day was 16.84 ppb. The results for turf show the peak EEC for photolysis set at $t_{1/2}$ = 0 days (stable) was 16.82 ppb and the peak EEC for photolysis set at $t_{1/2}$ = 1 day was 16.82 ppb. Outputs (including the 21-day and 60-day EECs) are located in **Appendix F**.

These results demonstrate that varying the aqueous photolysis input parameter has minimal effect on aquatic exposure values and potential risks. Because aqueous photolysis is the only significant rapid degradation pathway of aminocyclopyrachlor, this conservative TTR approach shows that aquatic exposure to the degradates would not result in any additional potential risks over those presented from exposure to the parent compound unless the degradates were a few to several orders of magnitude more toxic than the parent; submission of both aquatic and terrestrial toxicity data for the three degradates of concern, as predicted by SARs, has a low potential to add value to this ecological risk assessment.

5.3 Threatened and Endangered Species Concern

To determine whether the proposed use sites for a pesticide are geographically associated with known locations of listed species, a screening-level search of the LOCATES (version 2.10.3) database is conducted. The database compared county-level location data for listed species with county-level crop production data (as available in the 2002 agricultural census) to identify any coarse overlaps of listed species with the proposed labeled uses of aminocyclopyrachlor. Listed species are those that are currently on the Federal list of endangered and threatened wildlife and plants.

Because proposed uses of aminocyclopyrachlor do not confine its use to any geographic regions, aminocyclopyrachlor may be used all over the United States. According to the potential direct and indirect effects in **Table 5.4**, every federally listed species may be affected by the proposed uses of aminocyclopyrachlor. Therefore, a LOCATES analysis was not conducted.

5.3.1 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and so conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that listed species are located within an assumed area, which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. This risk assessment presents the use of aminocyclopyrachlor and establishes initial co-location of species with treatment areas.

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxa, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects upon listed species that depend upon the taxonomic group covered by the RQ as a resource. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites could be considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps could consider how this information would impact the action area for a particular listed organism and may potentially include areas of exposure that are downwind and downstream of the pesticide use site.

5.3.2 Taxonomic Groups Potentially at Risk: Direct Effects

Based on available screening level information, for the proposed uses of aminocyclopyrachlor, there is a potential for direct effects to listed terrestrial plants. Due to lack of acceptable data for the acid, direct effects are assumed for birds (chronic) and freshwater invertebrates (chronic). Consequently, direct effects must be assumed for estuarine/marine invertebrates (chronic); however, receipt of a chronic freshwater invertebrate study could eliminate this assumption. There is a potential concern for indirect effects upon the listed organisms by, for example, perturbing habitat, forage or prey availability. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-endangered organisms in these taxonomic groups as resources critical to their life cycle. A summary of the risk conclusions and direct and indirect effects determinations is presented in **Table 5.6**. Because the proposed uses of aminocyclopyrachlor cannot be geographically limited, all federally listed species may be either directly or indirectly affected.

Table 5.6. Potential Listed Species Risks Associated with Direct or Indirect Effects Due to the Proposed Applications of Aminocyclopyrachlor

Listed Taxonomy	Direct Effects	Indirect Effects[2]
Terrestrial and semi-aquatic plants – monocots	Yes	Yes
Terrestrial and semi-aquatic plants – dicots	Yes	Yes
Terrestrial invertebrates	No	Yes
Birds (surrogate for terrestrial-phase amphibians and reptiles)	No – acute Assumed[1] – chronic	Yes
Mammals	No – acute No – chronic	Yes
Aquatic vascular plants	No	Yes
Aquatic non-vascular plants	No	Yes
Freshwater fish (surrogate for aquatic-phase amphibians)	No – acute No – chronic	Yes
Freshwater Invertebrates	No – acute Assumed[1] – chronic	Yes
Freshwater Benthic Invertebrates	No – acute Assumed[1] – chronic	Yes
Estuarine/Marine Fish	No – acute No – chronic	Yes
Estuarine/Marine Crustaceans	No – acute Assumed[1] – chronic	Yes
Estuarine/Marine Mollusks	No	Yes

[1]Direct effects assumed in the absence of acceptable data for the acid.
[2]Indirect effects are possible for all taxa due to the direct effects to terrestrial and semi-aquatic plants.

The LOCATES database (version 2.9.7) identifies those U.S. counties that include non-crop and turf areas and that have federally-listed endangered or threatened species that may be directly or indirectly affected. The list of affected species derived from LOCATES was not included in this assessment because the uses cover most of the United States and the direct and indirect effects includes most species. With additional refinement by exploring more detailed use patterns and species biology (e.g., geographic location, specific feeding habits, time of year likely to utilize crop fields), some species listed may be determined to be not likely to be affected.

5.3.3 Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Individual Effect Chance Model (Version 1.1), developed by the Environmental Fate and Effects Division, is used by the Agency to calculate the chance or probability of an individual mortality (effect) corresponding to the listed species' acute LOCs and calculated RQs. The model, which is an Excel spreadsheet tool, allows for calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. The generated information serves as a guide to establish the need for and the extent of additional analysis that may be performed as well as evaluations of the geographical and temporal nature of the exposure to make an effect determination.

Because screening-level acute LOCs were calculated and exceeded for only terrestrial and semi-aquatic plants in this assessment, probit analysis was not conducted. The endpoints of terrestrial plant studies include emergence, survival, shoot height, and dry weight rather than single mortality events.

5.3.4 Indirect Effects Analysis

The Agency acknowledges that pesticides have the potential to exert indirect effects upon the listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, etc. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-endangered organisms in these taxonomic groups as resources critical to their life cycle.

Based on direct risk to terrestrial plants, there may be potential indirect effects to aquatic and terrestrial species that depend on these organisms (including their surrogates) as a source of food or habitat, including riparian habitats. Terrestrial plants serve several important habitat-related functions for listed species. In addition to providing habitat and cover, terrestrial vegetation also provides shelter for and cover from predators while foraging. Terrestrial plants also provide energy to the terrestrial ecosystem through primary production. Upland vegetation including grassland and woodlands provides cover during dispersal. Riparian vegetation helps to maintain the integrity of aquatic systems by providing bank and thermal stability, serving as a buffer to filter out sediment, nutrients, and contaminants before they reach the watershed, and serving as an energy source.

6 Description of Assumptions, Uncertainties, Strengths, and Limitations

6.1 Assumptions and Limitations Related to Exposure for all Taxa

There are a number of areas of uncertainty in the aquatic and terrestrial risk assessments. The toxicity assessment for terrestrial and aquatic animals is limited by the number of species tested in the available toxicity studies. Use of toxicity data on representative species does not provide information on the potential variability in susceptibility to acute and chronic exposures.

This screening-level risk assessment relies on labeled statements of the maximum rate of aminocyclopyrachlor application, the maximum number of applications, and the shortest interval between applications. Together, these assumptions constitute a maximum use scenario. The frequency at which actual uses approach these maximums is dependant on resistance to the herbicide, timing of applications, and market forces.

6.2 Assumptions and Limitations Related to Exposure for Terrestrial Species

Variation in habitat and dietary requirements

For screening terrestrial risk assessments, a generic bird or mammal is assumed to occupy either the treated field or adjacent areas receiving pesticide at a rate commensurate with the treatment rate on the field. The habitat and feeding requirements of the modeled species and the wildlife species may be different. It is assumed that species occupy, exclusively and permanently, the treated area being modeled. This assumption leads to a maximum level of exposure in the risk assessment.

The acute studies have a fixed exposure period, not allowing for the differences in response of individuals to different durations of exposure. Further, for the acute oral study, aminocyclopyrachlor is administered in a single dose which does not mimic wild birds' exposure through multiple feedings. Also, it does not account for the effect of different environmental matrices on the absorption rate of the chemical into the animal. Because exposure occurs over several days, both the accumulated dose and elimination of the chemical from the body for the duration of the exposure determine the exact exposure to wildlife, however they are not taken into account in the screening assessment. There was also no assumption of an effect of repeated doses that change the tolerance of an individual to successive doses.

Variation in diet composition

The risk assessment and calculated RQs assume 100% of the diet is relegated to single food types foraged only from treated fields. The assumption of 100% diet from a single food type may be realistic for acute exposures, but diets are likely to be more variable over longer periods of time. This assumption is likely to be conservative and will tend to overestimate potential risks for chronic exposure, especially for larger organisms that have larger home ranges. These large animals (*e.g.*, deer and geese) will tend to forage from a variety of areas and move on and off of treated fields. Small animals (*e.g.*, mice, voles, and small birds) may have home ranges smaller than the size of a treated field and will have little or no opportunity to obtain foodstuffs that have not been treated with aminocyclopyrachlor. Even if their home range does cover area outside the treated field, aminocyclopyrachlor may have runoff to areas adjacent to the treated field.

Exposure routes other than dietary

Only dietary and incidental ingestion of contaminated soils exposure is included in the exposure assessment. Other exposure routes are possible for animals in treated areas. These routes include ingestion of contaminated drinking water, dermal contact, inhalation, and preening. Because aminocyclopyrachlor does not volatilize appreciably, inhalation does not appear to be a significant contributor to the overall exposure. Given that aminocyclopyrachlor is soluble in water there exists the potential to dissolve in runoff and puddles on the treated field may contain the chemical. If toxicity is expected through any of these other routes of exposure, then the risks of a toxic response to aminocyclopyrachlor is underestimated in this risk assessment.

Dietary Intake - The Differences Between Laboratory and Field Conditions

There are several aspects of the dietary test that introduce uncertainty into calculation of the LC_{50} value (Mineau, *et al.*, 1994; ECOFRAM, 1999). The endpoint of this test is reported as the concentration mixed with food that produces a response rather than as the dose ingested. Although food consumption sometimes allows for the estimate of a dose, calculations of the mg/kg/day are confounded by undocumented spillage of feed and how consumption is measured over the duration of the test. Usually, if measured at all, food consumption is estimated once at the end of the five-day exposure period. Further, group housing of birds undergoing testing only allows for a measure of the average consumption per day for a group; consumption estimates can be further confounded if birds die within a treatment group. The exponential growth of young birds also complicates the estimate of the dose; controls often nearly double in size over the duration of the test. Since weights are only taken at the initiation of the exposure period and at the end, the dose per body weight (mg/kg) is difficult to estimate with any precision. The interpretation of this test is also confounded because the response of birds is not only a function of the intrinsic toxicity of the pesticide, but also the willingness of the birds to consume treated food.

Further, the acute and chronic characterization of risk rely on comparisons of wildlife dietary residues with LC_{50} or NOAEC values expressed in concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. On gross energy content alone, direct comparison of a laboratory dietary concentration- based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 - 2.5 for most food items. Only for seeds would the direct comparison of dietary threshold to residue estimate lead to an overestimate of exposure.

Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 - 80%, and mammal's assimilation ranges from 41 - 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (e.g., a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

Finally, the screening procedure does not account for situations where the feeding rate may be above or below requirements to meet free living metabolic requirements. Gorging behavior is a possibility under some specific wildlife scenarios (e.g., bird migration) where the food intake rate may be greatly increased. Kirkwood (1983) has suggested that an upper-bound limit to this behavior might be the typical intake rate multiplied by a factor of 5. In contrast is the potential for avoidance, operationally defined as animals responding to the presence of noxious chemicals in their food by reducing consumption of treated dietary elements. This response is seen in nature where herbivores avoid plant secondary compounds.

In the absence of additional information, the acute oral LD_{50} test provides the best estimate of acute effects for chemicals where exposure can be considered to occur over relatively short feeding periods, such as the diurnal feeding peaks common to avian species (ECOFRAM, 1999).

Incidental Pesticide Releases Associated with Use

This risk assessment is based on the assumption that the entire treatment area is subject to aminocyclopyrachlor application at the rates specified on the label. In reality, there is the potential for uneven application of aminocyclopyrachlor through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas of the treated field that are associated with specifics of the type of application equipment used (e.g., increased application at turnabouts when using older application equipment).

6.3 Assumptions and Limitations Related to Exposure for Aquatic Species

The fate and transport database for aminocyclopyrachlor was sufficient to conduct aquatic modeling for exposure assessment of aquatic species. The GENEEC model was used to produce estimated exposure concentrations. Because no RQs exceeded LOCs for aquatic species, these exposure estimates did not need to be refined by using PRZM/EXAMS. Because aminocyclopyrachlor is a new chemical, no monitoring data were available to compare to the model estimates.

6.4 Assumptions and Limitations Related to Effects Assessment

As described in **Sections 2.2.3** and **2.6.2**, the lack of acceptable data for the acid, ester, and certain degradates results in effects uncertainties for the respective taxa. However, for many taxa, alternate methods and additional weights of evidence could be used to describe potential risks. For taxa, such as freshwater and estuarine/marine invertebrates (chronic) and birds (chronic), where alternate approaches could not be used in the absence of data, risks cannot be precluded for non-listed and listed species.

Age class and sensitivity of effects thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The screening risk assessment acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies and mayflies, and third instar for midges). Similarly, acute dietary testing with birds is also performed on juveniles, with mallard being 5-10 days old and quail 10-14 days old.

Testing of juveniles may overestimate toxicity of older age classes for pesticide active ingredients, such as aminocyclopyrachlor, that act directly (without metabolic transformation) because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. The screening risk assessment has no current provisions for a generally applied method that accounts for this uncertainty. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, the risk assessment uses the most sensitive life-stage information as the conservative screening endpoint.

Use of the Most Sensitive Species Tested

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoint reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. In the case of listed species, there is uncertainty regarding the relationship of the listed species' sensitivity and the most sensitive species tested.

The Agency is not limited to a base set of surrogate toxicity information in establishing risk assessment conclusions. The Agency also considers toxicity data on non-standard test species when available.

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Appendix A. GENEEC Output

Parent:

Non-crop aerial (spray)

```
RUN No.   1 FOR ACP Acid         ON    Non-Crop       * INPUT VALUES *
--------------------------------------------------------------------
  RATE (#/AC)    No.APPS &    SOIL   SOLUBIL    APPL TYPE NO-SPRAY INCORP
   ONE(MULT)     INTERVAL     Koc    (PPM )     (%DRIFT)    (FT)     (IN)
--------------------------------------------------------------------
 .284(   .284)    1    1      12.0 2810.0    AERL_B( 13.0)      .0     .0

 FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
 METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
  (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)     (POND)     (POND)
--------------------------------------------------------------------
  373.00         2          N/A       7.80-  967.20       .00    967.20

 GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
--------------------------------------------------------------------
     PEAK        MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
     GEEC        AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
--------------------------------------------------------------------
    16.86         16.85          16.79         16.64         16.53
```

Non-crop ground (spray)

```
RUN No.   1 FOR ACP Acid         ON    Non-Crop       * INPUT VALUES *
--------------------------------------------------------------------
  RATE (#/AC)    No.APPS &    SOIL   SOLUBIL    APPL TYPE NO-SPRAY INCORP
   ONE(MULT)     INTERVAL     Koc    (PPM )     (%DRIFT)    (FT)     (IN)
--------------------------------------------------------------------
 .284(   .284)    1    1      12.0 2810.0    GRHIFI(  6.6)      .0     .0

 FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
 METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
  (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)     (POND)     (POND)
--------------------------------------------------------------------
  373.00         2          N/A       7.80-  967.20       .00    967.20

 GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
--------------------------------------------------------------------
     PEAK        MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
     GEEC        AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
--------------------------------------------------------------------
    16.47         16.46          16.40         16.26         16.15
```

Turf ground (granule)

RUN No. 1 FOR ACP Acid ON Turf * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
.108(.307)	3 30	12.0	2810.0	GRANUL(.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
373.00	2	N/A	7.80- 967.20	.00	967.20

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
16.82	16.81	16.75	16.60	16.50

Appendix B. T-REX Output

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs
1 application at 0.284 lb a.e./acre

Table B-1. Upper Bound Kenaga, Acute Avian Dose-Based Risk Quotients

Size Class (grams)	Adjusted LD50	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	0.00	144.14	#DIV/0!	66.06	#DIV/0!	81.08	#DIV/0!	9.01	#DIV/0!	2.00	#DIV/0!
100	0.00	82.19	#DIV/0!	37.67	#DIV/0!	46.23	#DIV/0!	5.14	#DIV/0!	1.14	#DIV/0!
1000	0.00	36.80	#DIV/0!	16.87	#DIV/0!	20.70	#DIV/0!	2.30	#DIV/0!	0.51	#DIV/0!

Table B-2. Upper Bound Kenaga, Subacute Avian Dietary Based Risk Quotients

LC50	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	126.56	#DIV/0!	58.01	#DIV/0!	71.19	#DIV/0!	7.91	#DIV/0!

Size class not used for dietary risk quotients

Table B-3. Upper Bound Kenaga, Chronic Avian Dietary Based Risk Quotients

NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	126.56	#DIV/0!	58.01	#DIV/0!	71.19	#DIV/0!	7.91	#DIV/0!

Size class not used for dietary risk quotients

Table B-4. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients

Size	Adjuste	EECs and RQs

Class (grams)	d LD50	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	0.00	120.66	#DIV/0!	55.30	#DIV/0!	67.87	#DIV/0!	7.54	#DIV/0!	1.68	#DIV/0!
35	0.00	83.40	#DIV/0!	38.22	#DIV/0!	46.91	#DIV/0!	5.21	#DIV/0!	1.16	#DIV/0!
1000	0.00	19.34	#DIV/0!	8.86	#DIV/0!	10.88	#DIV/0!	1.21	#DIV/0!	0.27	#DIV/0!

Table B-5. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients								
LC50 (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	126.56	#DIV/0!	58.01	#DIV/0!	71.19	#DIV/0!	7.91	#DIV/0!

Size class not used for dietary risk quotients

Table B-6. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients								
NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
5000	126.56	0.03	58.01	0.01	71.19	0.01	7.91	0.00

Size class not used for dietary risk quotients

Table B-7. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients											
Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	797.81	120.66	0.15	55.30	0.07	67.87	0.09	7.54	0.01	1.68	0.00
35	645.52	83.40	0.13	38.22	0.06	46.91	0.07	5.21	0.01	1.16	0.00
1000	279.21	19.34	0.07	8.86	0.03	10.88	0.04	1.21	0.00	0.27	0.00

Appendix C. TerrPlant Output

1 application at 0.108 lb a.e./acre (ground – granule)

Table C-1. EECs for Aminocyclopyrachlor		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.0054
Runoff to semi-aquatic areas	(A/I)*R*10	0.054
Spray drift	A*D	0
Total for dry areas	((A/I)*R)+(A*D)	0.0054
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.054

Table C-2. RQ Values for Plants in Dry and Semi-aquatic Areas Exposed to Aminocyclopyrachlor through Runoff and/or Spray Drift*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	0.11	1.13	<0.1
Monocot	listed	0.14	1.37	<0.1
Dicot	non-listed	10.19	101.89	<0.1
Dicot	listed	11.02	110.20	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

1 application at 0.094 lb a.e./acre (ground – spray)

Table C-3. EECs for Aminocyclopyrachlor		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.0047
Runoff to semi-aquatic areas	(A/I)*R*10	0.047
Spray drift	A*D	0.00094
Total for dry areas	((A/I)*R)+(A*D)	0.00564
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.04794

Table C-4. RQ Values for Plants in Dry and Semi-aquatic Areas Exposed to Aminocyclopyrachlor through Runoff and/or Spray Drift*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	0.12	1.00	0.16
Monocot	listed	0.14	1.22	0.34
Dicot	non-listed	10.64	90.45	12.53
Dicot	listed	11.51	97.84	1205.13
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

1 application at 0.284 lb a.e./acre (ground – spray)

Table C-5. EECs for Aminocyclopyrachlor		
Description	**Equation**	**EEC**

Runoff to dry areas	(A/I)*R	0.0142
Runoff to semi-aquatic areas	(A/I)*R*10	0.142
Spray drift	A*D	0.00284
Total for dry areas	((A/I)*R)+(A*D)	0.01704
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.14484

Table C-6. RQ Values for Plants in Dry and Semi-aquatic Areas Exposed to Aminocyclopyrachlor through Runoff and/or Spray Drift*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	0.36	3.02	0.49
Monocot	listed	0.43	3.68	1.01
Dicot	non-listed	32.15	273.28	37.87
Dicot	listed	34.78	295.59	3641.03
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

1 application at 0.284 lb a.e./acre (aerial – spray)

Table C-7. EECs for Aminocyclopyrachlor

Description	Equation	EEC
Runoff to dry areas	(A/I)*R	0.0142
Runoff to semi-aquatic areas	(A/I)*R*10	0.142
Spray drift	A*D	0.0142
Total for dry areas	((A/I)*R)+(A*D)	0.0284
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.1562

Table C-8. RQ Values for Plants in Dry and Semi-aquatic Areas Exposed to Aminocyclopyrachlor through Runoff and/or Spray Drift*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	0.59	3.25	2.45
Monocot	listed	0.72	3.96	5.07
Dicot	non-listed	53.58	294.72	189.33
Dicot	listed	57.96	318.78	18205.13
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix D. RQ Methods and LOC Definitions

The Risk Quotient Method is the means by which the Environmental Fate and Effects Division (EFED) integrates the results of exposure and ecotoxicity data. In this method, both acute and chronic risk quotients (RQs) are calculated by dividing exposure estimates by the most sensitive ecotoxicity values derived from the studies. Calculated RQs are then compared to OPP's levels of concern (LOCs). The LOCs are the criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use, and for listed species. Risk presumptions, along with the corresponding RQs and LOCs are summarized in the table below.

Table C-1. Levels of Concern for Assessed Taxa

Risk Presumption	RQ	LOC
Birds		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Mammals		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Aquatic Animals		
Acute Risk	EEC/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Listed Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1
Aquatic Plants		
Acute Risk	EEC/EC_{50}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1

Appendix E. ECOSAR Outputs

IN-LXT69

SMILES : c1(C2CC2)ncc(CL)c(N)n1
CHEM :
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C7 H8 CL1 N3
MOL WT : 169.61
Log Kow: 1.01 (KowWin estimate)
Melt Pt:
Wat Sol: 8453 mg/L (WskowWin estimate)

ECOSAR v1.00 Class(es) Found

Anilines (Aromatic Amines)

ECOSAR Class	Organism	Predicted Duration	End Pt	mg/L (ppm)
Anilines (Aromatic Amines) :	Fish	96-hr	LC50	80.220
Anilines (Aromatic Amines) :	Fish	14-day	LC50	212.499
Anilines (Aromatic Amines) :	Daphnid	48-hr	LC50	2.527
Anilines (Aromatic Amines) :	Green Algae	96-hr	EC50	9.897
Anilines (Aromatic Amines) :	Fish		ChV	0.376
Anilines (Aromatic Amines) :	Daphnid		ChV	0.052
Anilines (Aromatic Amines) :	Green Algae		ChV	6.529

Neutral Organic SAR :	Fish	96-hr	LC50	897.019
(Baseline Toxicity) :	Daphnid	48-hr	LC50	459.298
:	Green Algae	96-hr	EC50	131.980
:	Fish		ChV	87.035
:	Daphnid		ChV	35.617
:	Green Algae		ChV	39.875

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect.

Anilines (Aromatic Amines):

For Fish Acute Toxicity Values: 2,3,5,6-Tetrachloroaniline is 19 times more toxic than predicted by this SAR. Tetrabromoaniline may be more toxic than predicted by this SAR as well.

For Daphnid and Green Algae Toxicity Values: Tetrachloro- and tetrabromaniline may be 20 times toxic than predicted by this SAR.

N-Substituted anilines are less toxic than predicted by these SARs; for these compounds, Neutral Organic SARs are used.

ECOSAR v1.00 SAR Limitations:

Maximum LogKow: >7.8 (Fish 96-hr LC50, Daphnid 48-h LC50)
Maximum LogKow: >3.7 (Fish 14-day LC50)
Maximum LogKow: >4 (Green Algae 96-hr EC50 and ChV)
Maximum LogKow: >4.3 (Fish ChV)
Maximum LogKow: >2.4 (Daphnid ChV)
Maximum Mol Wt: 1000

Baseline Toxicity SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)

Maximum Mol Wt: 1000

Degradate: IN-QFH57

SMILES : c1(C2CC2)nc(C(#N))c(C(=O)O)n1
CHEM :
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C8 H7 N3 O2
MOL WT : 177.16
Log Kow: 0.83 (KowWin estimate)
Melt Pt:
Wat Sol: 6030 mg/L (WskowWin estimate)

ECOSAR v1.00 Class(es) Found

Imidazoles-acid

ECOSAR Class	Organism	Predicted Duration	End Pt	mg/L (ppm)
--> Acid moeity found: Predicted values multiplied by 10				
Imidazoles-acid	: Fish	96-hr	LC50	1135.075
Imidazoles-acid	: Daphnid	48-hr	LC50	13.191
Imidazoles-acid	: Fish	ChV		101.028 !
Imidazoles-acid	: Daphnid	ChV		0.912 !
Neutral Organic SAR	Fish	96-hr	LC50	1332.358
(Baseline Toxicity)	Daphnid	48-hr	LC50	667.463
:	Green Algae	96-hr	EC50	178.090
:	Fish	ChV		129.792
:	Daphnid	ChV		50.132
:	Green Algae	ChV		52.060

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect.

Note: ! = exclamation designates: The toxicity value was determined from a predicted SAR using established acute-to-chronic ratios and ECOSAR regression techniques which are documented in the supporting Technical Reference Manual. When possible, this toxicity value should be considered in a weight of evidence approach.

Imidazoles:

For Fish and Daphnid Acute Toxicity Values: If the log Kow of the chemical is greater than 5.0, or if the compound is solid and the LC50 exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For Green Algae Acute Toxicity Values: If the log Kow of the chemical is greater than 6.4, or if the compound is solid and the EC50 exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For All Chronic Toxicity Values: If the log Kow of the chemical is greater than 8.0, or if the compound is solid and the ChV exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

ECOSAR v1.00 SAR Limitations:

Maximum LogKow: 5.0 (LC50)
Maximum LogKow: 6.4 (EC50)
Maximum LogKow: 8.0 (ChV)
Maximum Mol Wt: 1000

Baseline Toxicity SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)
Maximum Mol Wt: 1000

IN-Q3007

SMILES : C1CC1C(=O)N
CHEM :
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C4 H7 N1 O1
MOL WT : 85.11
Log Kow: -0.37 (KowWin estimate)
Melt Pt:
Wat Sol: 2.623E+005 mg/L (WskowWin estimate)

ECOSAR v1.00 Class(es) Found

Amides

ECOSAR Class	Organism	Duration	End Pt	Predicted mg/L (ppm)
Amides	: Fish	96-hr	LC50	814.468
Amides	: Daphnid	48-hr	LC50	202.630
Amides	: Green Algae	96-hr	EC50	0.853
Amides	: Fish		ChV	4.815
Amides	: Daphnid		ChV	2.673 !
Amides	: Green Algae		ChV	0.142
Neutral Organic SAR	: Fish	96-hr	LC50	6585.711
(Baseline Toxicity)	: Daphnid	48-hr	LC50	2854.948
	: Green Algae	96-hr	EC50	466.243
	: Fish		ChV	658.740
	: Daphnid		ChV	173.542
	: Green Algae		ChV	109.548

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect.

Note: ! = exclamation designates: The toxicity value was determined from a predicted SAR using established acute-to-chronic ratios and ECOSAR regression techniques which are documented in the supporting Technical Reference Manual. When possible, this toxicity value should be considered in a weight of evidence approach.

Amides :

No limitations known at this time.

ECOSAR v1.00 SAR Limitations:

Maximum LogKow: >8.5 (LC50)
Maximum LogKow: >8.0 (EC50,ChV)
Maximum Mol Wt: 1000

Baseline Toxicity SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)
Maximum Mol Wt: 1000

IN-V0977

SMILES : C1CC1C(=O)O
CHEM :
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C4 H6 O2
MOL WT : 86.09
Log Kow: 0.88 (KowWin estimate)
Melt Pt:
Wat Sol: 9.145E+004 mg/L (WskowWin estimate)

ECOSAR v1.00 Class(es) Found

Neutral Organics-acid

ECOSAR Class	Organism	Duration	End Pt	Predicted mg/L (ppm)
--> Acid moeity found: Predicted values multiplied by 10				
Neutral Organics-acid	: Fish	96-hr	LC50	6377.040
Neutral Organics-acid	: Fish	14-day	LC50	6332.874
Neutral Organics-acid	: Daphnid	48-hr	LC50	3048.696
Neutral Organics-acid	: Green Algae	96-hr	EC50	890.978
Neutral Organics-acid	: Fish	30-day	ChV	616.478
Neutral Organics-acid	: Daphnid		ChV	296.122
Neutral Organics-acid	: Green Algae		ChV	282.620
Neutral Organics-acid	: Fish (SW)	96-hr	LC50	9651.102
Neutral Organics-acid	: Mysid Shrimp	96-hr	LC50	14107.002
Neutral Organics-acid	: Fish (SW)		ChV	488.811
Neutral Organics-acid	: Mysid Shrimp (SW)		ChV	1697.774
Neutral Organics-acid	: Earthworm	14-day	LC50	1954.255

Note: * = asterisk designates: Chemical may not be soluble
enough to measure this predicted effect.

Neutral Organics:

For Fish LC50 (96-h), Daphnid LC50, Mysid: If the log Kow is greater than 5.0, or if the compound is solid and the LC50 exceeds the water solubility by 10X, no effects at saturation are predicted.

For Fish LC50 (14-day) and Earthworm LC50: If the log Kow is greater than 6.0, or if the compound is solid and the LC50 exceeds the water solubility by 10X, no effects at saturation are predicted.

For Green Algae Acute Toxicity Values: If the log Kow of the chemical is greater than 6.4, or if the compound is solid and the EC50 exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For All Chronic Toxicity Values: If the log Kow of the chemical is greater than 8.0, or if the compound is solid and the ChV exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints:

ECOSAR v1.00 SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50, Mysid LC50)
Maximum LogKow: 6.0 (Fish 14-day LC50; Earthworm LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)
Maximum Mol Wt: 1000

IN-YY905

SMILES : C1CC1C(=N)N
CHEM :
CAS Num:
ChemID1:
ChemID2:
ChemID3:
MOL FOR: C4 H8 N2
MOL WT : 84.12
Log Kow: -1.72 (KowWin estimate)
Melt Pt:
Wat Sol: 1E+006 mg/L (WskowWin estimate)

ECOSAR v1.00 Class(es) Found

Aliphatic Amines

ECOSAR Class	Organism	Predicted Duration	End Pt	mg/L (ppm)
Aliphatic Amines	: Fish	96-hr	LC50	2559.187
Aliphatic Amines	: Daphnid	48-hr	LC50	119.684
Aliphatic Amines	: Green Algae	96-hr	EC50	15.333
Aliphatic Amines	: Fish		ChV	32.172
Aliphatic Amines	: Daphnid		ChV	0.023
Aliphatic Amines	: Green Algae		ChV	16.327
Aliphatic Amines	: Fish (SW)	96-hr	LC50	2642.790
Aliphatic Amines	: Mysid Shrimp (SW)	96-hr	LC50	124.511
Aliphatic Amines	: Green Algae (SW)	96-hr	EC50	15.246
Aliphatic Amines	: Fish (SW)		ChV	32.172
Aliphatic Amines	: Mysid Shrimp (SW)		ChV	0.023
Aliphatic Amines	: Green Algae (SW)		ChV	13.870
Neutral Organic SAR	: Fish	96-hr	LC50	91250.281
(Baseline Toxicity)	: Daphnid	48-hr	LC50	33580.477
	: Green Algae	96-hr	EC50	3145.013
	: Fish	ChV		9404.913
	: Daphnid	ChV		1606.282
	: Green Algae	ChV		576.973

Note: * = asterisk designates: Chemical may not be soluble enough to measure this predicted effect.

Aliphatic Amines:

For Fish 96-hr LC50: For aliphatic amines with log Kow greater than 7.0, a test duration of greater than 96 hrs may be required for proper expression of toxicity. Also, if the toxicity value obtained by the use of this equation exceeds the water solubility (measured or estimated), mortalities greater than 50% would not be expected in a saturated solution during an exposure period of 96 hrs.

For Daphnid 48-hr LC50: For aliphatic amines with log Kow greater than 5.0, a test duration of greater than 48 hrs may be required for proper expression of toxicity. Also, if the toxicity value obtained by the use of this equation exceeds the water solubility (measured or estimated), significant mortalities would not be expected in a saturated solution during an exposure period of 48 hrs.

For Green Algae Acute Toxicity Values: If the log Kow of the chemical is greater than 7, or if the compound is solid and the EC50 exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For Mysid Shrimp Acute Toxicity Values: If the log Kow of the chemical is greater than 6, or if the compound is solid and the EC50 exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For Fish and Daphnid Chronic Toxicity Values: If the log Kow of the chemical is greater than 8.0, or if the compound is solid and the ChV exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

For Green Algae Chronic Toxicity Values: If the log Kow of the chemical is greater than 7.0, or if the compound is solid and the ChV exceeds the water solubility by 10X, no effects at saturation are predicted for these endpoints.

ECOSAR v1.00 SAR Limitations:

Maximum LogKow: 6.0 (Fish, Mysid LC50)
Maximum LogKow: 5.0 (Daphnid LC50)
Maximum LogKow: 7.0 (Green Algae EC50)
Maximum LogKow: 8.0 (Fish, Daphnid ChV)
Maximum LogKow: 7.0 (Green Algae ChV)
Maximum Mol Wt: 1000

Baseline Toxicity SAR Limitations:

Maximum LogKow: 5.0 (Fish 96-hr LC50; Daphnid LC50)
Maximum LogKow: 6.4 (Green Algae EC50)
Maximum LogKow: 8.0 (ChV)
Maximum Mol Wt: 1000

Appendix F: GENEEC Outputs for Total Toxic Residue Approach

RUN No. 1 FOR ACP Acid ON Non-Crop Half-Life= 0 days

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
.284(.284)	1 1	12.0	2810.0	AERL_B(13.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
373.00	2	N/A	.00- .00	.00	.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
16.86	16.86	16.86	16.84	16.83

RUN No. 2 FOR ACP Acid ON Non-Crop 1 Half-Life= 1 day

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
.284(.284)	1 1	12.0	2810.0	AERL_B(13.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
373.00	2	N/A	1.00- 124.00	.00	124.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
16.84	16.77	16.34	15.39	14.71

RUN No. 1 FOR ACP Acid ON Turf Half-Life= 0 days

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
.108(.307)	3 30	12.0	2810.0	GRANUL(.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
373.00	2	N/A	.00-	.00	.00	.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
16.82	16.82	16.82	16.80	16.79

RUN No. 2 FOR ACP Acid ON Turf Half-Life= 1 day

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
.108(.307)	3 30	12.0	2810.0	GRANUL(.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
373.00	2	N/A	1.00-	124.00	.00	124.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
16.82	16.75	16.31	15.36	14.69